p16 turnitin

by P16 Darmawijoyo

Submission date: 24-Jun-2023 03:47PM (UTC+0700)
Submission ID: 2121796227
File name: P16.pdf (1.34M)
Word count: 3233
Character count: 17479

The impact of using function derivative teaching material based on APOS theory towards students' learning interest

IOP Conf. Series: Journal of Physics: Conf. Series **1480** (2020) 012022 doi:10.1088/1742-6596/1480/1/012022

The impact of using function derivative teaching material based on APOS theory towards students' learning interest

S Samosir[1*], Darmawijoyo[2], Y Hartono[2]

[1]Student of Mathematics Education, Universitas Sriwijaya
[2] Lecturers in Mathematics Education, Universitas Sriwijaya

[*]Corresponding author's email: sangkotsamosir123@gmail.com

Abstract. This study aims to describe students' interest in learning using functional materials based on the APOS Theory assisted by Geogebra. The research method used is qualitative type descriptive. The subjects of this study were students of the eleventh graders of Natural Science Study Program of SMAN 2 Palembang (The State Senior High School). Data collection was carried out by distributing questionnaires and interviews to find out the impact of the use of teaching materials on student interest in learning and tests to determine the impact of teaching materials on student learning outcomes. All data collected was analysed descriptively.

1. Introduction

Derivative (differential) is one part of calculus, a branch of Mathematics. In everyday life, the use of derivatives can be found in the rate of change, in the function of population growth, the speed of an object that moves and so on [1], the derivative as the rate of change in the value of the function of the magnitude of the change that occurs with the value of the change toward zero. Understanding derivative concepts begins with understanding the concepts of rate of change, instantaneous velocity, and tangent slope [1]. Understanding the concept of derivatives starts from understanding the concept of the rate of change and the slope of the graph involving functions and changes [2]. In teaching activities at classroom a teacher always use the materials needed. What a material needed is called as the teaching material [3].The subject material of derivatives in the 2013 curriculum is taught in class XI (eleventh) includes the notion of derivatives, the nature of derivative functions of algebra, the application of function derivatives algebra, stationary values, up and down functions, tangent and normal lines[4]. Some functional derivative teaching materials were developed such as Functional Learning Materials Using Web Media [5], Functional Learning Materials Using Model Eliciting Activities [6], the development of contextual-based learning tools based on derivative subjects in Madrasah Aliyah Negeri (The State of Islamic Senior High School) 3 Palembang [7], the development of instructional materials based on the inquiry approach to the material derived from trigonometric functions [8], and derivative function material based on APOS theory assisted with Geogebra [9]. "APOS Theory is our elaboration of the mental constructions of actions, processes, objects, and schemas. In studying how students might learn a particular mathematical concept, an essential ingredient which the researcher must provide is an analysis of the concept in terms of these specific constructs."[10]

This theory explains how a person uses his cognitive structure in constructing knowledge through the stages of action, process, objects and schemes [10]. Furthermore, Meagher stated that APOS theory is able to make someone develop their way of thinking so that abstract mathematical concepts can be assimilated and studied [11]. Even according to Maharaj focusing mathematics learning at the action, process and object stages can make mathematics learning more meaningful [12]. In view of APOS

Theory mathematical concepts can be understood through the stages of Action, Process, Object and Schema. Where each stage has its respective focus, namely Action on the ability of individuals to implement certain procedures, the process of contemplation (interiozation) of an action (one or several), the object of a comprehensive understanding of concepts, and the scheme of coordination between Action, Process and Objects [13]. Based on APOS theory, a person's scheme of a mathematical concept can be explained by genetic decomposition. A genetic decomposition is a model used to explain how a mathematical concept can be learned by students. With this genetic decomposition, students can find out how to construct a mathematical concept [13]

One computer program (software) that can be used as a medium for learning mathematics is the GeoGebra program. GeoGebra was developed by Markus Hohenwarter in 2001. GeoGebra is a computer program (software) to teach mathematics especially geometry and algebra [14]. The GeoGebra program is very beneficial for both teachers and students. Unlike the use of commercial software that usually can only be used at school, GeoGebra can be installed on a personal computer and used anytime and anywhere by students [14]. For teachers, GeoGebra offers an effective opportunity to create an interactive online learning environment that allows students to explore various mathematical concepts. A number of studies show that GeoGebra can drive the process of student discovery and experimentation in class [14]. Its visualization features can effectively assist students in demonstrating various mathematical conjectures.

Meanwhile, interest in learning mathematics also plays as one of an important supporting factors. Students are said to be interested in a lesson if the students pay attention, participate actively and feel happy with the lesson. Interest is a sense of preferability and a sense of interest in a thing or activity, without anyone asking [15]. Interest is related to the style of motion that encourages a person to deal with or deal with people, objects, activities, experiences directly by the activity itself [16], also adds by saying that in a learning process, an interest plays important role as a psychological aspect of someone who manifests themselves in several symptoms such as passion, desire, feeling like to do the process of behavior change through various activities which include seeking knowledge and experience, in other words learning interest is attention, like, someone's interest in learning that is shown through enthusiasm, participation and active in learning[17]. For every human, it is necessary for him/her to have the process of learning in order to get the knowledge, skills, belief, and habit acquisition. This process is called as an education. To get this education, the school is one as the answer to fulfill it. There are many methods, strategies or learning media used to trigger students used by those institutions. Beside facilities supported by schools as the example of external factors, the students must possess the internal factors: such as talent, motivation, interest and potency [18]. Students who have interest, they will have good feeling towards an object [6]. In their learning, students with the great interest are eager to pay attention in order to engage in learning activities and the result, it makes students better in their learning performance [19]. Interest, as one of the crucial part in internal factors, has the great influence in one's learning success n failure in learning outcomes. A student who has high interest, he will have high motivation too. It means a student who has great interest in learning mathematics, he will have a great motivation and it leads him to have positive attitude in mathematics. To provoke the students to get the high interest, the school must have the good teachers and approach or strategies applied in teaching and learning activities [20]. Students might have the fun and involve actively in reconstructing knowledge and understanding in their thinking stages in the fit approach applied. In the hierarchical learning, four stages can be applied: (1) concrete phase (2) semi-concrete phase (3) semi-abstract phase (4) abstract phase. While cognitive development theory suggests four stages of thinking of each individual in receiving knowledge, namely (1) sensorimotor stage (2) pre-operation (3) concrete operational stage (4) formal operational stage [21]. This development theory will provide the students to understand that mathematics is very closely to their daily lives. Interest can help them to remember the materials and the concepts learned along with understanding the materials interrelatedness. It will not appear students who learn mathematics frustration. The students will have the benefit; they do not feel bored or monotonous while learning since solving the mathematical problems related to daily life.

Based on the explanation above, it can be concluded that interest in mathematics is a student's psychology aspect which includes good provoked emotion, attention or willing to mathematics. Implementing APOS Theory assisted by Geogebra is expected to provide students' potency and interest

in learning derivatives. Having an interest in mathematics makes them participate and engage in teaching and learning activity actively. So from the description above, the author is interested in conducting research with the title "The Impact of Using Functional Learning Materials Based on APOS Theory Based on Geogebra on Students' Interest and Learning Outcomes".

2. Method

This type of research is a descriptive qualitative research. This study was conducted on three stages, i.e. preparation, implementation and analysis. In the preparation stage, the researcher prepared several instruments, including teaching materials, observation instruments, questionnaires and interview. In his observation time, the author was helped by the teachers. The observers observed the students during the activity based on the available observation instruments. After doing it, then the students were asked to fill out the questionnaires individually. At the implementation stage, student work on the activity sheet. There were two kinds of activities done by students. The first, it was about students' activity used the APOS theory stages. They understood that the derivative is limit function. In the second activity, they did the task by answering three questions about derivative function. Questionnaire data were analysed per student and the scores were calculated based on Likert scale.

3. Result and Discussion

Before this teaching material were given to the students, it has been which categorized as valid and practical. The writer firstly consulted it to the experts, and they validated it. The objects on research subject are forty students from the eleventh grade of Natural Science Program 1 of SMAN 2 Palembang. It was conducted in three meetings. In its implementation, the students were divided into 7 (seven) groups, each of them has member around five or six. Based on the 2013 curriculum, beside using five basic points: observing, asking, gathering information, associating, and communicating, a teacher must be able as the facilitators to learners in constructing their own knowledge. So, the writer created each group to read, discuss and conduct activities based on teaching material in order to be able to solve the problems given. In the third meeting, at end of learning, students were given individual task to drill them.

In the first meeting, students were given teaching material about the concept of the tangent gradient of the curve is the same as the first derivative of the function which also is

$$\text{m} = f'(c) = \lim_{h \to 0} \frac{f(c+h)-f(c)}{h}$$

In the second meeting, students were given teaching material about concepts of the function graph will rise when $f'(x) > 0$, stationary when $f'(x) = 0$ and the graph will go down when $f'(x) < 0$.From the questionnaire result that has been given to students contains indicators and descriptors of learning interest that cannot be seen with an observation sheet. The writer offeredtwenty five questions to the students to know more their interest and the impact of APOS theory of teaching materials developed in their learning achievement. It is essential for the researchers to use the questionnaire in order to find further information from the respondents [22]. This questionnaire contains 5 (five) questions about the correlation of interest towards their math learning achievement and 20 (twenty) were about the impact of APOS theory used in derivative function. Questionnaire data were analysed per student and the scores were calculated based on Likert scale. For the answers strongly agree (SA) is 4, agree (A) is 3, disagree (NS) are 2, and strongly disagree (STS) is 1.

Those questions are divided into two parts, the first, from number one to five are questions about students' interest in learning (Interest is needed in learning Mathematics, whether they ask questions about things that they don't understand yet, whether understanding the material is much better mastered by students who have great interest than students who lack it, their responses of teacher's question during apperception and their enjoyment working their group in and whether students listen to and pay attention to the teacher's explanation) and the rest, questions number six to twenty five are about the impact of APOS theory in students' learning derivatives (reading and using the steps in the activity, answering the questions on the activity carefully and with pleasure, discussing mathematical ideas and reflect mathematical ideas spontaneously assisted by APOS theory since they focused more on understanding the concepts given, Geogebra is very helpful in the stages of APOS theory helped them in understanding

the function graph and curve gradients.From the scores obtained, each student's interest category can be determined and presented in Table 1.

Table 1. The Percentage of students' interest.

Score Interval	Predicate	Total of Student	Percentage
60.5 - 74	Very Interested	18	45 %
46-59.5	Interested	22	55 %
	Total	40	100 %

Before the author got the percentage of students' interest, he calculated it with this formula below. The formula of average score of each aspect

$$\mathbf{X} = \frac{1}{thenumberofresponden} \text{ x } \frac{\sum_i^n x}{n}$$

Note:
X = average ; $\sum_i^n x$ = the number of scores for each aspect
n = the number of statements of each aspect

The writer offered twenty five questions to the students to know more their interest and the impact of APOS theory of teaching materials developed in their learning achievement. Based on the table above, it is found that the percentage of students who got a predicate of interest is 55% or as many as 22 students, and the predicate was very interested in 45% or as many18 students. Based on the results above it can be seen that from all students, they have high interest in learning derivative. This shows that teaching materials developed by researchers already have a potential effect on students' interest in learning.

The final test was held in the third meeting. There were five questions. The type was essay. The value for each number is twenty, so the total score was 100. Based on test result, it was concluded that the students' result gave a potential effect to obtain a learning outcomes assessment category. Then scores were obtained as in the following table.

Table 2. Students' test result.

No	Score Interval	Total of Students	Note
1	50 – 59	6	Not Complete
2	60 – 69	9	Not Complete
3	70 – 79	11	Complete
4	80 – 89	10	Complete
5	90 – 100	4	Complete

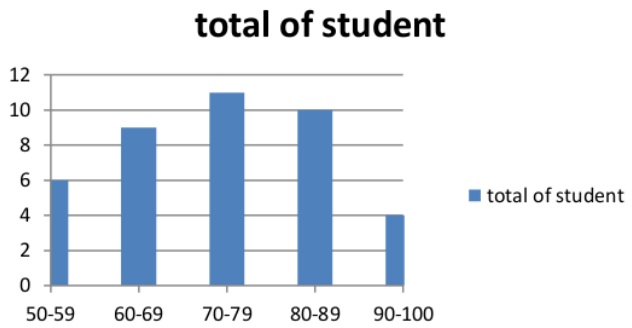

Figure 1. Total of students completing KKM.

Based on the Minimum Completeness Criteria (KKM) in SMAN 2 Palembang, that is 70, the number of students who get completion score are 25 students, and not completion score are 15students with an average value of 74.49. It means 62, 5 % as the score percentage of students who completed the minimum completeness criteria.

4. Conclusion

After using process of learning and testing, the author draws that students' interest in learning using functional learning materials based on the APOS Theory assisted by Geogebra were high.It was found that the percentage of students who have a predicate of interest is 55% or as many as 22 students, and the predicate is very interested in 45% or as many as 18 students from forty students of the eleventh graders of Natural Science Study Program of SMAN 2 Palembang (The State Senior High School)with Minimum Completeness Criteria (KKM) is 70 with the number of students who get completion score were 25 students, and not completion score were 15 students with an average value of 74.49.

Based on the results above it can be seen that from all students, they have a high interest in learning derivative. This shows that teaching materials developed by researchers already have a potential effect on students' interest in learning.

5. References

[1] Weber E, et al 2012 *Mathematics Teacher* **104** 274
[2] Orhun N 2012 *Procedia Soc. Behav. Sci.* **55** 679
[3] Ahmadi 2011 *Strategi Pembelajaran Sekolah Terpadu (*Jakarta: Prestasi Putra Karya)
[4] Kemendikbud 2013 *Peraturan Menteri Pendidikan dan Kebudayaan Republik Indonesia No 69 Tahun 2013* (Jakarta: Kemendikbud)
[5] Oktaria D, Zulkardi Z, and Somakim S 2013 *Jurnal Kependidikan Penelitian Inovasi Pembelajaran* **43** 1
[6] Sukiman D, Darmawijoyo D, and Somad S 2018 *Jurnal Kependidikan Penelitian Inovasi Pembelajaran* **2** 85

[7] Tati T, Zulkardi Z and Hartono Y 2013 *JPM* **3** 56
[8] Alfani F M 2017 *JPM* **6** 86
[9] Samosir S 2018 *Prosiding Seminar Nasional Pendidikan dan Lokakarya PISA* p 120
[10] Dubinsky E and McDonald M A 2001 *The Teaching and Learning of Mathematics at University Level: An ICMI Study* pp 275
[11] Meagher M, Cooley L, Martin B, Vidakovuc D and Loch S 2006 *PME-NA 2006 Proceedings* **2** 84
[12] Maharaj A 2013 *S. Afr. J. Educ.* **33** 1
[13] Asiala et al 2001 *The Development of Students' graphical understanding of derivative graphical* (New York: Routledge)
[14] Hohenwarter M and Fuchs K 2004 Combination of Dynamic Geometry, Algebra, and Calculus in the Software System GeoGebra
[15] Vainikainen M P, Salmi H, and Thuneberg, H 2015 *Journal of Research in STEM Education* **1** 1
[16] Renninger K A and Su S 2012 The Oxford handbook of human motivation In *interest and Its Development* (New York: Oxford University Press) pp 167-187
[17] Siagian R E F 2015 *Jurnal Ilmiah Pendidikan MIPA* **2** 12
[18] Slameto 2015 *Belajar dan Faktor Faktor Yang Mempengaruhinya (*Jakarta:Rineka Cipta)
[19] Akwan M T, Ijaz A and Ikhram H 2017 IJET **2** 88
[20] Arthur Y D, Oduro F T and Boadi R K 2014 *Int. Jour. Edu. Res.* **2** 661
[21] Santrock J W 2012 *Life-Span Development. Eds XIII Jilid 1 (*Jakarta: Erlangga)
[22] Sugiyono 2016 *Metode Penelitian Kuantitatif Kualitatif dan Kombonasi (Mixed Methoda)* (Bandung: Alfabeta)

p16 turnitin

ORIGINALITY REPORT

19%	17%	15%	7%
SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS

MATCH ALL SOURCES (ONLY SELECTED SOURCE PRINTED)

4%

★ download.atlantis-press.com

Internet Source

Exclude quotes	On	Exclude matches	< 1%
Exclude bibliography	On		