

A Survey Of 12th Grade Students' Errors In Solving Calculus Problems

Nguyen Phu Loc, Tran Cong Thai Hoc

Abstract: Calculus in high schools is a discipline of advanced mathematics. Its intrinsic complexity is very high. Many researchers around the world have pointed out difficulties and obstacles that students have encountered when studying it. To understand a concept and a theorem of calculus is not easy; therefore, when solving calculus problems students cannot avoid errors. Find out the errors of students in mathematics learning have been a problem that several of mathematics educators around the world interested in. In this paper, we report the answers to the following two research questions: (1) In solving calculus problems, what errors have 12th grade - students committed? (2) What are the teachers' opinions about how often the errors of the students have occurred? The data collection was performed in high schools in Tan Chau town, An Giang province, Vietnam

Index Terms- Mathematical error, Mathematical mistake, Error analysis, Learning calculus, Mathematical problem solving.

I. INTRODUCTION

Studies of students' errors in learning process are a necessary work of teachers teaching in schools. R. Marzano (1992) considered the student's error analysis is a method to extend and refine knowledge, and error analysis is: to determine what error is, what to lead to the error and how to prevent it. Also discussing the students' errors, N. P. Loc (2008) paid to special attention to error prediction and how to prevent students' errors in the process of teaching mathematics. About teachers' attitudes towards errors of students, Lagutko M. (2008) notioned that : "(1) teachers have to accept students' right to err"; (2) "teachers should try to understand student's error"; (3) "in the teaching process, teachers should teach students certain strategies, certain actions which increase their chances for a correct final solution". About learning mathematics, Legutko (2008) also believed that "students' errors are inevitable in learning mathematics; they ensue from mathematics itself or are results of teaching". Especially for calculus courses, according to the author N. P. Loc (2010), calculus have highly intrinsic complexity and often involves infinite process; therefore, students will encounter difficulties and obstacles while studying the subject, and will commit many errors when solving calculus problems. In mathematics curriculum in Vietnamese high schools, students of two final grades (11th grade and 12th grade) learn some topics of calculus such as: function limit, continuous function, derivative concept (11th grade); application of derivative to investigate a function, antiderivative concept, definite integral and application (12th grade). To find out errors that students have encountered in solving calculus, we conducted case study of Tan Chau Town, An Giang Province (Vietnam) with two following research questions:

1. During solving calculus problems, what errors have 12th grade students often committed?
2. What are opinions of teachers about how often the errors of the students have committed?

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Defining the concept

Mistake: an error caused by a lack of skill, attention, knowledge, etc. (The random house college dictionary – revised edition, 1998) **Error:** a deviation from accuracy or incorrectness; a mistake, as in action or speech. (The random house college dictionary – revised edition, 1998) Based on the above definitions, in this paper we define an error in solving problem as follows: *Error in solving problem* is an error caused by improperly implementing mathematical rules; by applying the incorrect mathematical formulas, mathematical theorems; or by misunderstanding concepts, theorems; by misunderstanding an assignment, or by making mistake in calculation and presenting problem solution.

II. METHODOLOGY

Content analysis: Analysis of 12th grade – students' solutions to assignments (essay) in examinations in the 2013-2014 school year was to find and classify the errors of the student when solving calculus problems. **Survey by questionnaire:** After sorting the errors of the students, we used questionnaires to find out the opinions of teachers about how often the errors of the student have committed.

Subjects of the survey:

-12th grade - students in school year 2013-2014 of four high schools in Tan Chau town, An Giang province, Vietnam. Specifically as follows (see Table 1).

Table 1: High Schools surveyed

School	Class	A number of students' solutions (essays)
Tan Chau High School (TC)	12A1, 12A2, 12A3, 12A4, 12E5	499
Nguyen Quang Dieu High School (NQD)	12A1, 12A4	225
Chau Phong High School (CP)	12A3, 12A4, 12A6	291
Đuc Tri High School (DT)	12A1, 12A2, 12A3, 12A4	285

-Teachers: 28 School mathematics teachers of four high schools where students were surveyed.

III. RESULTS AND DISCUSSION

3.1. Results

The answer to the first research question is presented in Table 2, and Table 3 shows the results of survey of teachers' opinions on how often students' errors have committed (the answer to the second research question).

Table 2. Different kinds of errors of students

School The kinds of errors	TC (%) n ₁ =49 9	NQD (%) n ₂ =22 5	CP (%) n ₃ =29 1	DT (%) n ₄ =28 5
1. Wrong calculations	14,1	41.3	51.5	31.6
2. Wrong domain of function (or expression)	26.3	17.3	61.9	63.2
3. Misunderstanding concept	6.5	25.3	5.2	10.5
4. Misunderstanding theorem, formula	2.7	10.6	5,7	17.9
5. Incorrect memory	12.8	58.7	46.4	54.7
Applying basic algorithms wrongly	19.2	21.3	27.8	35.1
7. Presenting solutions wrongly	11.5	18.7	13.4	21.6
8. Not paying attention to assumptions of a problem	1.3	26.7	10.3	12.6
9. Misconcept	9.6	5.3	8.2	13.7
10. Not exhausting all possibilities as possible	11.5	17.9	20.6	25.3

Table 3: Opinions of teachers towards students' errors (n=28)

The kinds of errors	Very often (%)	Sometimes (%)	Rarely (%)
1. Wrong calculations	71.4	28.6	0
2. Lack of condition	21.4	78.6	0
3. Misunderstanding concept	35.7	60.8	3.6
4. Misunderstanding theorem, formula	32.1	67.9	0
5. Incorrect memory	39.3	60.7	0
6. Applying basic techniques wrongly	28.6	71,4	0
7. Presenting solutions wrongly	57.1	42.9	0
8. Not paying attention assumption of a problem	14.3	67.8	17.9
9. Misconcept	28.6	67.8	3.6
10. Not exhausting all possibilities as possible	35.7	60.7	3.6
11. Others	0	0	0

3.2. Discussion

Through the results of two surveys, we see that students' errors in solving calculus problems were quite diverse and had so many different causes, and the teachers surveyed

agreed that such errors have occurred nearly as frequent in students. In addition, results showed that practical errors of the students were compatible with the comments on the characteristics of the calculus stated by N. P. Loc (2010) and M. Legutko (2008).

IV. CONCLUSION

The research results obtained as presented above allow us to conclude that in the process of learning mathematics in general and calculus in particular, students often encounter the errors; These errors are in several types. Therefore, teachers should have a positive attitude towards student's errors, and consider student's errors as feedback to adjust teaching methods; in addition, teachers should show students how to prevent errors, and see them as pedagogical measures to contribute to improving the quality of mathematics education in schools.

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