Students' Errors in Solving Problems on Coordinate Methods in Space: Results from an Investigation in Vietnam

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Abstract:

The paper presents the results of an investigation of 12th grade students and mathematics teachers in three secondary schools of Tam Binh district, Vinh Long province (Vietnam) towards errors happening to students in solving problems on "coordinate method in space" topic. From the investigation, we found that students often committed ten different errors in solving problems on the above topic. The mathematics teachers should have positive attitude towards students' errors because the error detection of students will offer teachers many benefits: (1) to recognize misunderstanding of their students; (2) to adjust their teaching; (3) to do action research to increase the effectiveness of their activities of teaching.

Key words: Error, error analysis, coordinate method in space, geometry teaching, mathematics education.

1. Introduction

One of among issues which many mathematics educators today is widely recognized is that in mathematics learning process,

students often make many errors. Towards errors of students in learning calculus in secondary schools, Hoc (2014) and Hoc & Loc (2014) found out 10 types of errors through the investigation of students and mathematics teachers. One question is that in learning process of coordinate methods in space, what errors have 12th grade students in Vietnamese secondary schools often committed? To find out the answer to the above question we conducted the study with following two research questions:

1. In solving problems on coordinate method in space, which errors have the 12th grade students in Vietnam often made?
2. What are mathematics teachers' opinions on the errors of students?

2. Background

Definition of an error
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 (Loc & Hoc, 2014).

Analysis of error
Marzano (1992) considered the student's error analysis as 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.

Teachers' attitude towards errors of students
 Lagutko (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.

Loc (2008, 2010) paid to special attention to error prediction and how to prevent students' errors in the process of teaching mathematics. He argued that teachers need to have a positive attitude towards the students' errors, and consider the student's errors as feedbacks to adjust teaching methods; in addition, teachers should give students ways to prevent errors, and see them as pedagogical measures to contribute to improving the quality of mathematics education in schools.

3. Methodology

Data collecting and data analysis
Content analyzing: Analyzing 12th grade – students' solutions to assignments (essay) in examinations in the academic year 2014-2015 was to identify and classify the errors of the students in solving problems on coordinate methods in space (see Table 1).
Survey by questionnaire: Using questionnaires to investigate 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 three schools in Tam Binh District, Vinh Long province, Vietnam (see Table 1).
- 27 mathematics teachers of three schools in which students were investigated.

Table 1: The number of solution-presented paper of students investigated

School	Class	The number of solution-presented paper of students
THCS– THPT Long Phú	12_1, 12_2, 12_3, 12_6	181
THCS – THPT Phú Thịnh	12_1, 12_2, 12_3, 12_4, 12_5, 12_7	201
THPT Phan Văn Hòa	12_1, 12_2, 12_3, 12_4, 12_5, 12_6, 12_7, 11_8, 12_9	309

4. Results and Discussion

For the first question

After analyzing solution – presented papers of students investigated, we found that the errors that students made when learning methods of spatial coordinates were varied. Table 2 shows us the types of error and the percentage of students in each type of error.

Table 2: Types of error of students in solving problems on coordinate methods in space

School \\ Type of error	Long Phú of n= 181 (%)	Phú Thịnh of n=201 (%)	Phan Văn Hòa of n=309 (%)
1. Wrongly calculating	56,9	50,2	49,2
2. Not pay attention to restriction of problem	54,7	32,3	45,6
3. Understanding concept incorrectly	29,8	14,9	21,7
4.Understanding theorem, formula incorrectly	33,1	22,4	28,9
5.Using mathematics theory incorrectly	56,9	35,8	42,4
6.Applying basic algorithms wrongly	38,1	20,9	39,5
7.Using incorrect language	57,5	59,2	46,6
8.Understanding exercise incorrectly	8,8	4,5	3,2
9.Misunderstanding mathematics knowledge	33,7	25,4	23,6
10.Not exhausting all possibilities as possible	17,1	4,5	4,2

For the second question

After classifying the errors of students as above, we sent questionnaire to mathematics teachers in three secondary schools in which students have been surveyed. Table 3 reports the opinions of teachers on how often the students in each type

of error, and also shows that the teachers surveyed agree that the such errors often happen to students in solving problems on coordinate method in space.

Table 3: Teachers' opinions on types of students'errors (N = 27)

Types of error	How often		
	Regularly (%)	Sometimes (%)	Rarely (%)
1. Wrongly calculating	40,7	55,6	3,7
2. Not pay attention to restriction of problem	44,4	55,6	0
3. Understanding concept incorrectly	33,3	55,6	11,1
4.Understanding theorem, formula incorrectly	25,9	66,7	7,4
5.Using mathematics theory incorrectly	33,3	66,7	0
6.Applying basic algorithms wrongly	37	59,3	3,7
7.Using incorrect language	55,6	44,4	0
8.Understanding exercise incorrectly	18,5	70,4	11,1
9.Misunderstanding mathematics knowledge	18,5	66,7	14,8
10.Not exhausting all possibilities as possible	11,1	70,4	18,5
11.Others	0	0	0

5. Conclusion

The results obtained as described above allow us to conclude that in the process of learning spatial coordinate method, students often make many errors. The mathematics teachers should have positive attitude towards students' errors because error detection of students will offer teachers many benefits: (1) to recognize misunderstanding of their students; (2) to adjust their teaching; (3) to do action research to increase the effectiveness of their activities of teaching.

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