ERROR ANALYSIS OF SENIOR HIGH SCHOOL STUDENTS IN SOLVING THE PROBLEMS OF STRAIGHT LINE ON THE COORDINATE PLANE

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Abstract

Problem-solving ability is an ability that must be had by students to complete the issue of straight-line equation. The capability of understanding the concepts and settlement procedures is absolutely necessary. The low absorptive capacity on the national exam and the previous studies indicate the magnitude of the inability of the students to solve the problems of a straight-line topic. Therefore, an analysis of the student's errors is needed to know the forms of the existing errors as a reference in the improvement of the learning.

This study aims to determine the forms of errors made by the students in solving the problems of straight line on the coordinate plane. The errors of the completion were classified into the conceptual and procedural errors. The errors were assessed using the indicators of conceptual and procedural errors proposed by Kastolan. This research is a quantitative study. The instrument used was the essay test about the straight-line equation materials.

The research resulted in the data of the forms of conceptual and procedural errors committed by the students in solving the problems of the essay test about the straight-line equation. The procedural errors found were in the forms of: a) errors in determining the formulas or theorems or definitions to solve a problem, made by 16,87% of students, b) the use of formulas, theorems, or definitions which did not match the prerequisite conditions for the application of them, made by 5,24% of students, and c) the absence of the formulas, theorems, or definitions of a problem, made by 30,77% of students. Meanwhile, the conceptual errors found were in the forms of: a) the steps of problem solving which were not hierarchically structured, made by 3,32% of students and b) an error or an inability to manipulate the steps to solve a problem, made by 48,25% of students.

Keywords: analysis, students' errors, straight-line equation, conceptual, procedural

INTRODUCTION

Education can be defined as the overall learning experience of each person throughout his life that takes place not within the limits of a certain age but lasts throughout life from birth to death (Mudyahardjo, 2002: 46).

Mathematics is the queen of sciences (Suherman Erman, 2001: 28-29). Locke (Sujono, 1988: 8) states that the study is a means to inculcate the habit of reasoning in one's mind. Studying it is a means to be able to learn a lot of other sciences. It becomes a subject in formal education. School is a means of formal education. Mathematics is taught as it is contained in the School-level Based Curriculum (SBC) in 2006.

National exam is a standardized evaluation system of primary and secondary education nationally and quality similarities of the education levels between regions done by the Centre of Educational Assessment, Ministry of Education in Indonesia based on the Law of the Republic of Indonesia Number 20 of 2003.

In Mathematics Modules of junior high school namely BERMUTU issued by PPPPTK Mathematics in 2011, it is stated that based on the report of the student's absorption on the national exam, those of basic competence regarding gradients, equations, and straight-line graphs were still below the average. The previous study also showed that in some areas, the same problems occurred, as experienced by the entire junior high school in Purbalingga in the academic year of 2009/2010 (Retno Dewi, 2012: 53). It was similar to what happened in SMP N 1 Nanggulan, Kulon Progo of which the score did not reach 50% of the minimum mastery of learning (Veronica Wiwik, 2012). Therefore, the researcher was moved to do the analysis of errors made by the students to solve the problems of straight-line material. In practice, the author chose the high school students of class X SMA Pangudi Luhur Van Lith as the research subjects. The selection was due to the fact that they came

from various junior high schools, not only from those around the high school. The author took the title of Error Analysis of High School Students in Solving Problems of Straight Line on the Coordinate Plane as the initial stage of the writer's interest to examine the aspects of the errors made by the students in solving math problems.

RESEARCH METHODS

Types of Research
This research is a quantitative study.

Time and Place of Research
The study was conducted on August 25, 2013 in the class X-1, X-2 and X-4 in SMA Pangudi Luhur Van Lith, Muntilan with one meeting in each class.

Research Subject
The subjects of the study were the senior high school students of Pangudi Luhur Van Lith class X-1, X-2 and X-4 in the academic year of 2013/2014.

Procedure
This study was preceded by executing a written test of the materials of straight-line equation. The works of the students were identified by using alternative answers that had been provided to categorize the observed errors to be elaborated later in the form of scanned documents representing every form of error. The grouped errors were the reexamined using the conceptual and procedural error indicators proposed by Kastolan (1992) to get the kinds of conceptual and procedural errors occurred. After that, the conceptual and procedural errors found were described.

Data, Instruments, and Data Collection Techniques
The data used in the research were the result of the student's work on the essay questionnaire about straight-line equation. The researcher acted as the key instrument who plays a role in the planning, implementation, data collection, data analysis and data interpretation. The instrument used was questionnaire containing essay questions about straight-line equation which consisted of 9 items of p27. The results obtained were in the form of the written data. The data collection was done by gathering information of the steps the students took in solving the problems of material straight-line equations.

Data Analysis Technique
1. Data reduction
   a. Matching the results of the student's work with the alternative answers.
   b. Grouping the work of right and wrong.
   c. Grouping by the common errors found.
   d. Classifying the errors into conceptual and procedural errors based on the error indicators suggested by Kastolan (1992).
2. Data Presentation
   Showing some scanned documents of some students that represented the common errors as well as a table of the conceptual and procedural errors found.
3. Conclusion Drawing
   Answering the formulation of the problem asked after doing the observation and data processing.

RESULTS AND DISCUSSIONS
The results shown by the essay test of materials of straight-line equation indicated the errors made by the students. The errors were made in an attempt to resolve the problems. Further studies were based on the conceptual and procedural error indicators proposed by Kastolan (1992). The indicators of the conceptual errors include: a) errors in determining the formulas or theorems or definitions to solve a problem, b) the use of formulas, theorems, or definitions which did not match the prerequisite conditions for the application of them, and c) the absence of the formulas, theorems, or definitions of a problem. Meanwhile, the conceptual errors consist of: a) the steps of problem solving which were not hierarchically structured and b) an error or an inability to manipulate the steps to solve a problem. Table 1 shows the results of the

assessment based on the conceptual and procedural error indicators.

Table 1. Conceptual and Procedural Errors

Nomor soal	Jumlah Siswa				
	Kesalahan Konseptual			Kesalahan Prosedural	
	a	b	c	a	b
1a	8	7	68	12	57
1b	9	4	76	0	56
2a	5	0	3	0	7
2b	11	1	3	2	23
3	13	1	6	1	19
4	4	1	19	5	49
5	23	9	18	4	50
6	28	19	38	9	74
7	27	6	24	3	61
8	18	9	46	1	65
9	47	3	51	1	91

The errors commonly found in number 1a about depicting a graph of straight-line equation were that the students did not understand the meaning of the gradient. An advanced error assessment based on the conceptual and procedural error indicators showed that:
a. 8 students made error in determining the formulas or theorems or definitions to answer the questions.
b. 7 students made error in the form of the use of formulas, theorems, or definitions which did not match the prerequisite conditions for the application of them.
c. 68 students did not write the formulas, theorems, or definitions to answer the questions.
d. 12 students were unable to resolve the problem using the hierarchically steps.
e. 57 students were unable to manipulate the steps to answer the questions.

A common error found in question 1b about depicting a graph of straight-line equation was that the students did not understand the meaning of the gradient. The further error assessment based on conceptual and procedural error indicators showed that:
a. 9 students made error in determining the formulas or theorems or definitions to answer the questions.

b. 4 students made error in the form of the use of formulas, theorems, or definitions which did not match the prerequisite conditions for the application of them.
c. 76 students did not write the formulas, theorems, or definitions to answer the questions.
d. 56 students were unable to manipulate the steps to answer the questions.

A common error found in question 2a about the straight-line gradient passing through the coordinates of the base and the point (x_1, y_1) was that the students using the wrong formula to find the value of the gradient. Further error assessment based on the conceptual and procedural error indicators showed that:
a. 5 students made errors in determining the formulas or theorems or definitions to answer the questions.
b. 3 students did not write the formulas, theorems, or definitions to answer the questions.
c. 7 students were unable to manipulate the steps to answer the questions.

A common error found in question 2b of the straight-line gradient passing through the two point coordinates was that the students made errors in doing the counting. Further error assessment based on the conceptual and procedural error indicators showed that:
a. 11 students made error in determining the formulas or theorems or definitions to answer the questions.
b. 1 student made error in the form of the use of formulas, theorems, or definitions which did not match the prerequisite conditions for the application of them.
c. 3 students did not write the formulas, theorems, or definitions to answer the questions.
d. 2 students were unable to resolve the problem using the hierarchically steps.
e. 23 students were unable to manipulate the steps to answer the questions.

A common error found in question 3 about the determination of the abscissa of a coordinate traversed by a straight line if the gradients, ordinate of the abscissa pair, and

another coordinate point through which the straight line traversed were known, was that the students using the wrong formulas to find out the value of the gradient. Further error assessment based on the conceptual and procedural error indicators showed that:

a. 13 students made error in determining the formulas or theorems or definitions to answer the questions.
b. 1 student made error in the form of the use of formulas, theorems, or definitions which did not match the prerequisite conditions for the application of them.
c. 6 students did not write the formulas, theorems, or definitions to answer the questions
d. 1 students was unable to resolve the problem using the hierarchically steps.
e. 19 students were unable to manipulate the steps to answer the questions.

A common error found on question 4 about determining the straight-line equation through the two points was that the students did not understand the question. Further error assessment based on the conceptual and procedural error indicators showed that:

a. 4 students made error in determining the formulas or theorems or definitions to answer the questions.
b. 1 student made error in the form of the use of formulas, theorems, or definitions which did not match the prerequisite conditions for the application of them.
c. 19 students did not write the formulas, theorems, or definitions to answer the questions.
d. 5 students were unable to resolve the problem using the hierarchically steps.
e. 49 students were unable to manipulate the steps to answer the questions.

A common error found in question 5 about the determination of the gradient of a straight line perpendicular with one equation known was that the students did not understand the question. Further error assessment based on the conceptual and procedural error indicators showed that:

a. 23 students made error in determining the formulas or theorems or definitions to answer the questions.
b. 9 students made error in the form of the use of formulas, theorems, or definitions which did not match the prerequisite conditions for the application of them.
c. 18 students did not write the formulas, theorems, or definitions to answer the questions.
d. 4 students were unable to resolve the problem using the hierarchically steps.
e. 50 students were unable to manipulate the steps to answer the questions.

A common error found in question 6 about the determination of the value of a variable in a straight-line equation if the line is parallel to a straight line of which equation was known was that the students do not understand the question. Further error assessment based on the conceptual and procedural error indicators showed that:

a. 28 students made error in determining the formulas or theorems or definitions to answer the questions.
b. 19 students made error in the form of the use of formulas, theorems, or definitions which did not match the prerequisite conditions for the application of them.
c. 38 students did not write the formulas, theorems, or definitions to answer the questions.
d. 9 students were unable to resolve the problem using the hierarchically steps.
e. 74 students were unable to manipulate the steps to answer the questions.

A common error found in question 7 about the determination of the straight-line equation passing through a point and parallel to another straight-line of which equation was known was that the students do not understand the question. Further assessment errors based conceptual and procedural error indicators showed that:

a. 27 students made error in determining the formulas or theorems or definitions to answer the questions.
b. 6 students made error in the form of the use of formulas, theorems, or definitions which

did not match the prerequisite conditions for the application of them.

c. 24 students did not write the formulas, theorems, or definitions to answer the questions.

d. 3 students were unable to resolve the problem using the hierarchically steps.

e. 61 students were unable to manipulate the steps to answer the questions.

A common error found in question 8 about the determination of the straight-line equation passing through a point and perpendicular to another straight line passing through the two points with the coordinates were known was that the students did not understand the question. Further error assessment based on the conceptual and procedural error indicators showed that:

a. 18 students made error in determining the formulas or theorems or definitions to answer the questions.

b. 9 students made error in the form of the use of formulas, theorems, or definitions which did not match the prerequisite conditions for the application of them.

c. 46 students did not write the formulas, theorems, or definitions to answer the questions.

d. 1 students was unable to resolve the problem using the hierarchically steps.

e. 65 students were unable to manipulate the steps to answer the questions.

A common error found in question 9 about the equation of two straight lines perpendicular to each other of which gradient and the point passed through were known and the two straight lines had the same point of intersection of the x-axis was that the students did not understand the question. Further error assessment based on the conceptual and procedural error indicators showed that:

a. 47 students made error in determining the formulas or theorems or definitions to answer the questions.

b. 3 students made error in the form of the use of formulas, theorems, or definitions which did not match the prerequisite conditions for the application of them.

c. 51 students did not write the formulas, theorems, or definitions to answer the questions.

d. 1 students was unable to resolve the problem using the hierarchically steps.

e. 91 students were unable to manipulate the steps to answer the questions.

CONCLUSIONS AND SUGGESTIONS

Conclusion

1. The forms of conceptual errors found in the student's work were:

   a. Errors in determining the formulas or theorems or definitions to solve a problem, made by 16,87% of students.

   b. The use of formulas, theorems, or definitions which did not match the prerequisite conditions for the application of the formulas, theorems, or definitions, made by 5,24% of students.

   c. The absence of the formulas, theorems, or definitions of a problem, made by 30,77% of students.

2. The conceptual errors found were in the forms of:

   a. The steps of problem solving which were not hierarchically structured, made by 3,32% of students.

   b. An error or an inability to manipulate the steps to solve a problem, made by 48,25% of students.

Suggestion

1. The further research study regarding the materials of straight-line equation is expected to pay attention to the research methods so that the results will be more focused.

2. The similar research studies can be done with different materials related to the errors made by the students.

3. For the educators of secondary level, they are expected to increase the student's interest in studying the materials of straight-line equation so that the concepts that become the weakness of the students will be better mastered.

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