ANALYSIS OF MASTERING SPACE GEOMETRY OF MATHEMATICS EDUCATION DEPARTMENT STUDENTS AT STAIN BUKITTINGGI

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Abstract:The background of the research is that the students' results of space and plane geometry subject were lowyear by year. Accordingly, the writer was interested to further know the students' comprehension. This research is a descriptive research where the instruments are test and interview. The samples of the research were the third semester of mathematics education students in academic year 2014/2015. The findings of the research: 1) the samples were unable to determine the position of line, intersecting line, or crossed line in a space,2) they were unable to draw distance between two crossed line in a space, 3) they were unable to determine the form of figure in a space, 4) they were unable to determine area and volume of two figures in a space, and 5) they were unable to count large of angle in a space.

Key-Words: Skill, Space geometry .

1. INTRODUCTION

In the context of curriculum, The National Council of Teachers of Mathematics (NCTM, 2000) determined five standards in mathematics namely number and its operation,problem solving, geometry, measuring, chance and analysis of data. In geometry there are visualization utilizing, spatial reasoning, and modeling elements as recommended byNCTM (1989)in Kariadinata (2010), *The mathematics curriculum for grade 9-12 should include the study of the geometry of two, and three dimensions so that all student can interpret and draw three-dimensional object; represent problem situations with geometric models and apply properties of figures.* In national curriculum in Indonesia, the students from elementary school until university are required to master space geometry materials.

Space geometry is a study about space things, relations, and formed transformations, and axyoma systems. To understand space geometry, the basic of geometry is

needed, as stated by Soemadi (1994): to learn geometry well, he students are required to know the basic of geometry, skill in proving, skill to draw basic geometry and good space view.

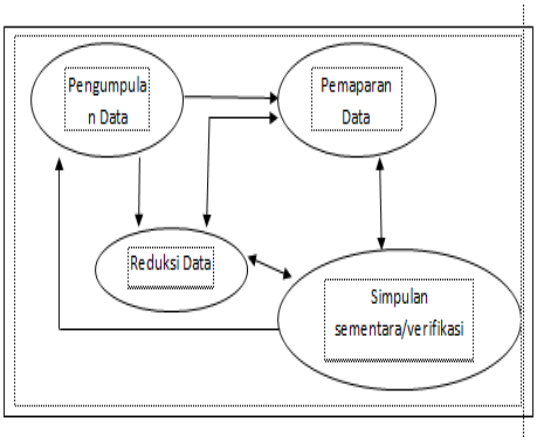
According toSusanta (1996) that geometry is admitted as an "obstacle" for the students even the mathematics lecturers.In line with the explanation above, after finishing to learn plane and space geometry, most of the students got C-. Likewise, the micro teaching lecturer said that the students found difficulties when facing space figure materials.

Based on the background of the problem above, the writer was interested to further analyze the third semester of mathematics students' comprehension of space geometry by the question research "How is the ability of space geometry of the third semester mathematics students at STAIN Bukittinggi in academic year 2014/2015?

2. RESEARCH METHOD

The qualitative method was used in this research. The samples were the third semester of mathematics students who learned space geometry they are 2 students with high capability, 4 students with moderate capability, and 2 students with low capability. The instruments used were test and interview. The test used was the adopted from the test developed by Suparyan.

The steps in analyzing the data: reduction,data display and conclusionsdrawing/verification.The interaction of analysis can be drawn as follow:



Sunarto (2001: 158)

3. RESULTS AND DISCUSSION

Mastering space geometry materials means that the subjects of the research are able to answer space geometry questions as the basic materials of plane and space geometry subject.

The materials are divided into five groups:

1. The capability of line position explained in no.1
2. The capability of distance explained in no.2
3. The capability of plane form explained in no.3a
4. The capability of area and volume of two space plane explained in no. 3b
5. The capability of angle explained in no.4a and 4b

Based on the results of analysis of the data taken from eight subjects of the research toward eight research subjects, it is found that number of mistakes in the following table:

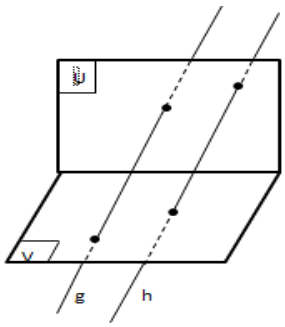
Table 4.2

Based on the research findings, it was found that group of materials about angle in a space at no.4b was in the maximum error that was 100%.

Kelompok materi geometri ruang	No Soal	Jawaban benar/salah berdasarkan kode								Jumlah kesalahan (%)
		T.01	T.02	S.03	S.04	S.05	5.06	R.07	R.08	
1. Kedudukan garis	1	S	B	S	S	S	S	S	S	87,5
2. Jarak	2	S	S	S	S	B	B	S	S	75
3. bentuk suatu Bangun	3a	S	B	S	S	S	S	S	S	87,5
4. Luas dan volum dua bangun ruang	3b	S	B	S	S	S	S	S	S	87,5
5. Sudut	4a	S	B	S	S	S	S	S	S	87,5
	4b	S	S	S	S	S	S	S	S	100

The students' ability of space geometry materials:

No. 1. Investigate whether the position of g line and h is in row, intersecting, or intercrossed.



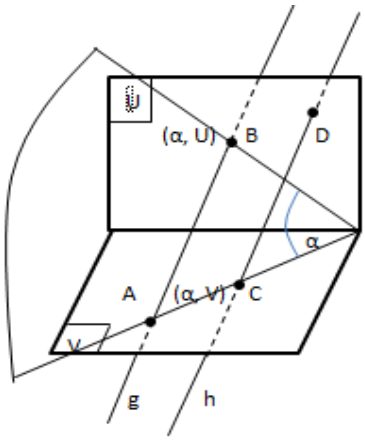
Answer:

If the g and h line are in line, both lines are in a plane and also if it is intersecting. Due to through two lines in a row and two intersecting lines, a plane can be made.If those two lines are intercrossing, it is will not be in a plane. There are several steps to determine whether the lines are in a plane:

1. Draw $\propto$ plane through three penetrated points of g and h lines(through point A, B and C)
2. Plane $\propto$intersect plane βin $(\propto, \beta)$
3. Plane$\propto$intersect plane$V$in $(\propto, V)$

4. If penetrated point D is not located in intersecting lines ($\propto, \beta$), it means that g and h lines are not in one plane.
5. Because g and h lines are not in a plane, the g and h lines are intercrossing.

   The figure of the following steps is drawn as follow:



Thus, the position of g and h lines are intercrossing

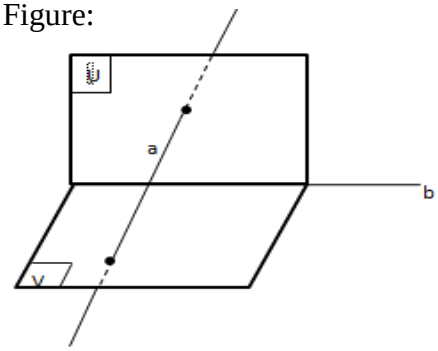
These are the answers from eight subject research:

Code	Answer	Explanation
T.01	Intersecting	False
T.02	Intercrossing	
S.03	In a row	True
S.04	In a row	False
S.05	In a row	False
S.06	In a row	False
R.07	In a row	False
R.08	In a row	

By noticing these answers, only one subject who correctly answered the question that was T.02 code, while the others deemed the position of the lines were in the plane and they cannot differ between the position of lines in a row, intersecting, and intercrossing.

2. Linea and b are drawn in the figure below. Draw the distance between line a and b.

   Figure:

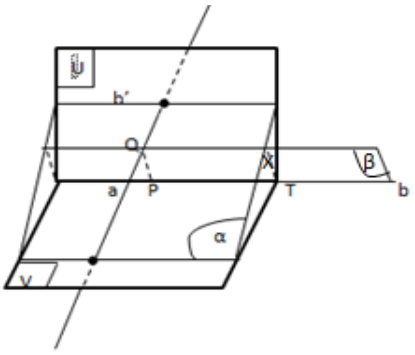


The correct answer:

There are several steps to draw two intersecting lines a and b:

1. Draw b' in row with b cutting line a
2. Draw a plane through line a and b' (plane)
3. Determine a point in line b (point T)
4. Draw line x through point T perpendicular plane∝
5. Draw a plane through line b and line x (planeβ)
6. Planeβ penetrated by a in point Q
7. Draw a line through point Q in row with line x cutting line P
8. PQ is the intended distance

   The figure based on the steps above:



The answers from whole the research subjects:

Code T.01

No distance between line a and b because it is intercrossing.

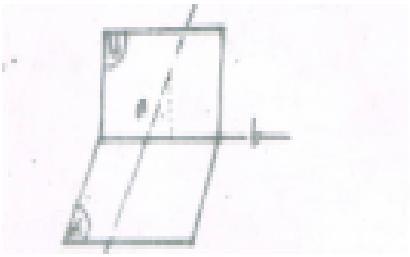
Code T.02

Line a perpendicular line b, so the distance between a and b = 0 because they met in one intersecting point.

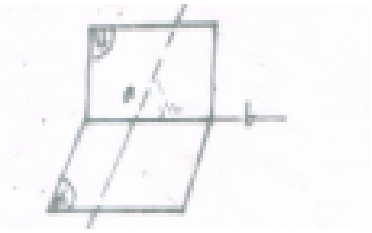
Code S.03

Not answered

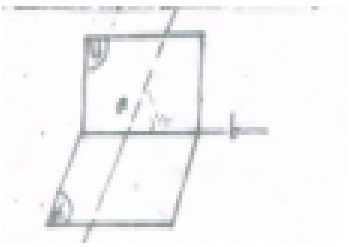
Code S.04



Code S.05



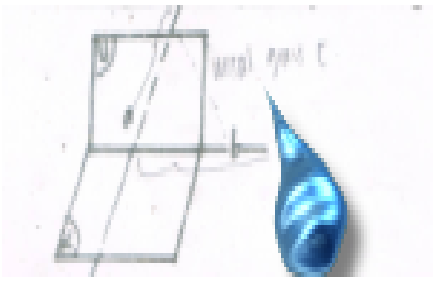
Code S.06



Code R.07

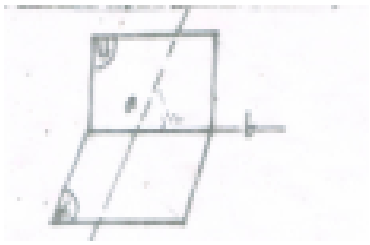
Not answered

Code R.08



By noticing these answers, two of eight subjects answered correctly although the steps of drawing could not be seen. The error of the answers happened because the students considered that two intercrossing lines do not have any distance. In general the research subjects did not master the materials about distance. .

Question no.3



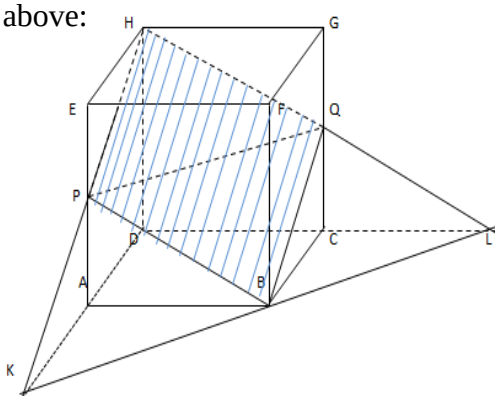
A cube of ABCD.EFGH with the edge length is a cm. Point P and Q in succession is edge midpoint AE and CG. Plane α through point H, P and Q. What form is the cut between planeα and cube and count its area.

The answer:

The steps to draw plane cut α and a cube:

1. Connect point H and point P, extension HP will cut extension DA in point K
2. Connect point H with point Q,extension HQ will cut extension DC in point L
3. Connect point K and point L, line KL affinity fuse
4. Line KL will pass point B
5. Connect point B with point P and point B with point Q
6. Its cut plane is plane HPBQ with HP = PB = BQ = QH
7. Cut plane between plane α and cube is HPBQ with all the sides are the same and the length of diagonal PQ = a√2 cm, and the length of diagonal HB = a√2 cm. Thus, the plane HPBQ is in rhomb form.

   The figure based on the steps above:



For example, the area of rhomb HPBQ = L with the diagonal PQ= d_1, diagonal HB = d_2, thus:

$L = ½\ d_1 \times d_2$

$= 1/2\ a\sqrt{2} \times a\sqrt{2}$

$= ½\ a^2\sqrt{6}$

The answers from whole research subjects:

Code T.01

3a. Cut between plane α with cube ABCD.EFGH is in triangle form....(false)

3b. L = $1/4a^2\sqrt{6}$unit.....(false)

Code T.02

3a. Cut between plane α with cube ABCD.EFGH is in rhomb form....(true)

3b. L = $1/2a^2\sqrt{6}$ cm^2 .....(true)

Code S.03

3a.Cut between plane α with cubeABCD.EFGH is in isosceles triangle form (false)

3b. L = $a\sqrt{2}$ x a /2.....(false)

Code S.04

3a. Cut between plane α with cubeABCD.EFGH is in right triangle form…(false)

3b. L = $3/4a^2$.....(false)

Code S.05

3a. Cut between plane α with cubeABCD.EFGH is in triangle form....(false)

3b. L = $1/2a\sqrt{6}$.....(false)

Kode S.06

3a. Cut between planeα with cubeABCD.EFGH is in… (no answer)

3b. L = ...not answer

Code R.07

3a. Cut between plane α with cubeABCD.EFGH is in triangle form (false)

3b. L = ...did not finish to answer the question

Code R.08

3a. Cut between plane α with cubeABCD.EFGH is in triangle form (false)

3b. L = ...did not finish to answer the question

By noticing these answers, from question no. 3a and 3b only one students who answered correctly. Most of the subjects answered that plane cut α in a cube with triangle because they only focused from the known edge and did not master how to draw the plane cut in a space. In general, whole subjects did not master how to draw plane cut in space.

N0.4

A cube ABCD.EFGH with edge length is a cm. Count the large of edge between line

a. $\overrightarrow{FC}$ and $\overrightarrow{FH}$
b. $\overrightarrow{DE}$ and $\overrightarrow{BG}$

The correct answer:

4a. Angle between line $\overrightarrow{FC}$ and $\overrightarrow{FH}$ is ∠ CFH because ∠ CFH equilateral, thus

∠ CFH = 60^0

4b. Projection line $\overrightarrow{DE}$ at plane BCGF is BG, thus angle between line $\overrightarrow{DE}$ and $\overrightarrow{BG}$ is the same with angle between $\overrightarrow{CF}$ and $\overrightarrow{BG}$ that is ∠ BTC = 90^0

The answers from whole research subjects:

Code T.01

4. Angle between lines

a. $\overrightarrow{FC}$ and $\overrightarrow{FH}$ is 90^0

b. $\overrightarrow{DE}$ and $\overrightarrow{BG}$ the angle was not formed

Code T.02

4. Angle between lines

a. $\overrightarrow{FC}$ and $\overrightarrow{FH}$ is 60^0 because it was formed from equilateral triangle
b. $\overrightarrow{DE}$ and $\overrightarrow{BG}$ the angle was not formed because the lines were intercrossing and intersecting (false)

S.03.

4. Angle between lines

a. $\overrightarrow{FC}$ and $\overrightarrow{FH}$ was 90^0 because it was formed from angle EFH (45^0)+ angle BFC (45^0).....(false)

b. $\overrightarrow{DE}$ and $\overrightarrow{BG}$ was 0^0 (the angle was not formed) because both lines were not interrelated.

S.04

4. Angle between lines

a. $\overrightarrow{FC}$ and $\overrightarrow{FH}$ was 180^0 ....(false)

b. $\overrightarrow{DE}$ and $\overrightarrow{BG}$ (not finished the answer)

Code S.05

4. Angle between lines

a. $\overrightarrow{FC}$ and $\overrightarrow{FH}$ was 90^0 because it was formed from angle GFC (45^0) angle GFH (45^0) ..(false)

b. $\overrightarrow{DE}$ and $\overrightarrow{BG}$ was .. no answer (False)

Code S.06

4. Angle between lines

a. $\overrightarrow{FC}$ and $\overrightarrow{FH}$ was.. no answer (false)

b. $\overrightarrow{DE}$ and $\overrightarrow{BG}$ was... no answer (false)

Code S.07

4. Angle between lines

a. $\overrightarrow{FC}$ and $\overrightarrow{FH}$ was 90^0 ... (false)

b. $\overrightarrow{DE}$ and $\overrightarrow{BG}$ was 90^0 ..(false)

Code S.08

4. Angle between lines

a. $\overrightarrow{FC}$ and $\overrightarrow{FH}$ was...(no result)

b. $\overrightarrow{DE}$ and $\overrightarrow{BG}$ was....(no result)

by noticing the answers for question number 4a, only one student who answered correctly because the subjects did not relate the lines formed from edge point H and C,question number 4bmany students did not answered completely. In general, the subjects did not master the materials about angle in the space.

4. CONCLUSION AND SUGGESTION

4.1. Conclusion

The students' weaknesses in mastering space geometry:

1. Almost all the research subjects could not determine the position of lines in a row, intersecting, or intercrossing line in a space.
2. Most of the research subjects could not draw the distance between two intercrossing lines in a space.

3. Most of the research subjects could not determine the form of figure in a space.
4. Most of the research subjects could not determine thearea and the volume of two figures in a space.
5. Most of the research subjects could not count the large of the edge in a space. Moreover, for the question about angle in part 4b, all the subjects could not determine the large of the angle in a space

4.2. Suggestion

Based on the findings, the writer proposed some suggestions:

1. The geometry lecturer (plane and space geometry, space geometry, plane and space analytic geometry, and space analytic geometry) use mathematics visual aids in teaching because the students' visualizing ability of space figure in some conditions was weak.
2. The mathematics laboratory should be completed by supporting visual aids (plane and space geometry, space geometry, plane and space analytic geometry, and space analytic geometry).
3. The lecturer (plane and space geometry, space geometry, plane and space analytic geometry, and space analytic geometry) should improve the students' spatial ability through three elements namely SP, MR and SR.
4. The students should strengthen their space geometry knowledge skill thorugh doing exercises.

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