Analysis of Mathematical Communication Skills in Submission of Field Geometry Based on The Van Hiele Theory

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Abstract. The purpose of this study was to analyzed of mathematical communication skills in submission of field geometry based on the van hiele theory. The research method used is descriptive analysis method using qualitative approach. The data collection technique used in this study is the test method. The subjects in this study were the 2018 STKIP class of mathematics education students at STKIP Pamane Talino in the Field Geometry course. The result from students of STKIP Pamane Talino in the Geometry Field course is (1) high-ability students capable of proving images into mathematical language and making symbols, making and providing good information about understanding and parts of points, lines and fields, can provide information about two possibilities of right triangles by using special angles, both relations between special angles that can, provide information and about information about its parts, can represent circular tangents and information about their parts, able to express circle resolution with right, and perceive relationships between properties and between figures (2) Students with moderate abilities cannot provide information about points, lines, and fields properly. The parts of the point, line, and field are not yet clear symbols, the information given about right triangles is not yet complete and the mathematical relations described are still incomplete about special angles, do not describe the circle of information, information about resolutions and their parts are conveyed with details, mathematical representation is still wrong, can use their own language when expressed again about circle resolution, and see figures as collections of properties (3) students with low ability cannot provide information about points, lines and fields and students are not able to symbolize points, lines and fields, and recognize figures by appearance alone, often by comparing them to a known prototype.

Keywords: Geometry Field, Mathematical Communication Skills, van Hiele’s Theory

PRELIMINARY

Student mathematical communication is still very low as evidenced by the lack of student participation when learning takes place. Students tend to be quiet and do not pay attention to the lecturer's explanation even they also do not respond when the lecturer asks them "are there any questions?". The importance of mathematical communication skills for students is that they can understand courses related to analysis, evaluation and even the use of the mathematical language Nartani, CI et al (2015: 1).

There are many ways to see communication skills in students during the learning process. Mathematical communication skills can be either verbal or written communication skills in mathematics. Oral communication skills can be in the form of communication between students...
and lecturers while learning, while communication skills in writing can be in the form of the ability to make pictures, graphics or mathematical symbols Sari, D S et al (2017: 3)

Mathematical communication indicators according to NCTM (2000) namely (1) compiling and consolidating their mathematical thinking through communication, (2) communicating their mathematical thinking logically and clearly with other students or with teachers, (3) analyzing and evaluating mathematical thinking and strategies other people's strategies and (4) using mathematical language to express mathematical ideas appropriately.

Meanwhile, according to Sumarmo (2012) indicators of mathematical communication skills, namely (1) stating situations, images, diagrams, or real objects into language, symbols, ideas, or mathematical models, (2) explaining mathematical ideas, situations, and relationships orally or writing, (3) Listening, discussing, and writing about mathematics, (4) reading with an understanding of a written mathematical representation and (5) re-expressing a description or paragraph of mathematics in one's own language.

The van Hiee theory describes how young people learn geometry. According to Vojkuvkova (2012) there are five levels of thinking or understanding in geometry: Level 0 is visualization, level 1 is analysis, level 2 is abstraction, level 3 is deduction and level 4 is rigor. Students pass through the level step by step. This hierarchical order helps them to achieve better understanding and results. The purpose of this study is to analyzed of mathematical communication skills in submission of field geometry based on the van hiele theory.

RESEARCH METHODS

The subjects in this study were 10 students of mathematics education in 2018 STKIP Pamane Talino consist of 3 males and 7 females. The research method used is descriptive analysis method with qualitative approach. The steps of this research are: 1) determining research subjects, 2) making research instruments, 3) validating research instruments, 4) data retrieval and 5) data analysis. The instrument used in this study was an essay test consisting of 4 questions in accordance with indicators of mathematical communication skills. The indicators of mathematical communication skill they are: 1) express a situation, picture, diagram, or real object into language, symbols, ideas, or mathematical models 2) explain ideas, situations, and mathematical relations orally or in writing 3) listening, discussing, and writing about mathematics 4) reading with an understanding of a written mathematical representation. The
validity instrument in this research is using content validity consist of 3 validators namely 1 lecturer and 2 teachers.

RESEARCH RESULTS AND DISCUSSION

Based on the selected indicators, the data obtained by using the appropriate essay test that is the indicator states the situation, pictures, diagrams or real objects into language, symbols, ideas, or mathematical models of students with high ability to be able to express images into mathematical language and make symbols points, lines and fields and can provide good information about the understanding and parts of points, lines and fields. Student able to declare images into mathematical language and make symbols of points, lines and fields and can provide good information about the understanding and parts of points, lines and fields. Student perceive relationships between properties and between figures (abstraction level of van Hiele theory).

Students with moderate abilities cannot provide information about points, lines and fields well. The parts of the points, lines, and fields are not yet clear symbols. Student can not provide information about points, lines and fields property. The part of the points, lines, and fields are not yet clearly symbols. Students see figures as collections of properties (analysis level of van Hiele theory).

Students with low ability cannot provide information about points, lines and fields and students have not been able to make symbols of points, lines and fields. Students can not provide information about points, lines, and fields and students have not been able to make a point, line, and plane symbols. Students recognize figures by appearance alone, often by comparing them to a known prototype (visualization level of van Hiele theory).

Further explanation can be seen in the following picture.
**Figure 1** High-ability student

- Titik adalah semua yang tidak memenuhi batik ukuran dan tidak dapat di lihat. Pada gambar di atas terdapat hampir 7 titik, termasuk titik A, B, dan C. Titik yang sangat banyak hingga memenuhi garis AB, BC, BA, CA, dan terdapat juga hampir 7 titik. Tanda tanda Segriga di atas yang tidak bisa di lihat.

- Garis adalah komposisi dari beberapa titik yang membentuk garis yang terlihat pada gambar di atas. Terdapat beberapa garis garis. Tanda tanda AB, BC, dan CA.

- Bidang adalah persekitaran yang melibatkan segitiga ABC. Dalam dua jenis plas, bidang di atas merupakan bidang di atas Segriga.

**Figure 2** Medium ability students


Bidang = lahiran keseluruhan dari pertemuannya antara garis ke titik yang membentuk gambar di atas. Lebih merupakan tumpuan dari titik - titik yang menjadi Segriga. Segriga di atas.
Figure 3 Low ability students

In the indicators explaining ideas, situations, and mathematical relations verbally or in writing students are able to make mathematical relations in writing. Students with high ability can provide information about two possible right angles by using special angles properly, containing the relationships between the specified angles. Students with moderate abilities of information given about right triangles are incomplete and the mathematical relations presented are still incomplete about special angles. Students with low ability can only mention one possible right triangle with a special angle.
Figure 4 High ability students
On indicators listen, discuss, and write about mathematics. Students with high abilities are able to disguise the circle and provide information about its parts. Students with moderate abilities do not disguise the circle but information about its definitions and parts is conveyed in detail. Students with low ability are able to make pictures and information about their definitions and parts are still wrong.
On the reading indicator with an understanding of a written mathematical representation, students with high ability can represent the tangents of circles and information about their parts. Students with mathematical representation ability are still having something wrong. Students with low ability cannot make mathematical representations about tangents to circles.
Figure 10 High ability students

Figure 11 Medium ability students
Figure 12 Low ability students

On indicators re-expressing a description or paragraph of mathematics in their own language, students with high ability are able to express the definition of a circle correctly. Students with moderate abilities can use their own language when re-expressing the definition of a circle. Students with low ability can provide information about the definition of a circle but it is not appropriate.

CONCLUSION

The results showed that the mathematical communication skills of student’s STKIP Pamane Talino in the Field Geometry based on van Hiele theory were (1) students with high abilities were able to express images into mathematical language and make symbols of points, lines and fields, and could provide good information about the understanding and parts of points, lines and planes, can provide information about the two possible triangles of right-angles by using special angles properly, containing the relations between special angles mentioned, being able to disguise circles and provide information about their parts, can represent the tangent picture of a circle and information about its parts, able to express the definition of a circle correctly, and perceive relationships between properties and between figures. (2) Students with moderate ability have not been able to provide information about points, lines and fields well. The parts of the points, lines, and fields are not yet clearly symbolized, the information provided about right triangles is incomplete and the mathematical relations presented are incomplete about special angles, do not depict circles, but information about definitions and parts is conveyed in detail, there is still a mathematical representation of something wrong, can use their own language when re-expressing the definition of circle, and see figures as collections of properties (3)
students with low ability can not provide information about points, lines and fields and students have not been able to make symbols of points, lines and fields. Further explanation can be seen in the following figure, the information provided about the right triangle is incomplete and the mathematical relations described are still incomplete about the special angle, can only mention one possible right triangle with a special angle, able to make drawings and information about the definition and parts are still wrong, not yet able to make a mathematical representation of the tangents of a circle, can provide information about the definition of a circle but not yet right, and recognize figures by appearance alone, often by comparing them to a known prototype.

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REFERENCES


