Daya Matematis : Jurnal Inovasi Pendidikan Matematika
Volume, 9 Nomor 3 December 2021 Hal. 178 - 185
p-ISSN:2541-4232 dan e-ISSN: 2354-7146

Analysis of Students' Difficulties in Distance Materials in Space Based on Anderson's Knowledge Dimension

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(***Received***:20-10-2021; ***Reviewed:*** 2-11-2021; ***Revised:*** 15-11-2021; ***Accepted:*** 20-11-2021; ***Published:*** 20-12-2021)

Abstract
This study analyzes the difficulties of students in the distance material in space based on the dimensions of Anderson's knowledge in class XII.IPA SMA Negeri 2 Banjar in the academic year 2021/2022. The purpose of this study was to determine the difficulties of students in the distance material in space based on the dimensions of Anderson's knowledge. The background of the research is that learning on distance material in class XII.IPA SMA Negeri 2 Banjar has not achieved the learning objectives. Students have difficulty understanding the material. The research subjects were 9 students from class XII.IPA SMA Negeri 2 Banjar for the academic year 2021/2022. Subject selection was based on a purposive sampling technique selected based on different academic abilities (high, medium, and low) and able to communicate verbally well. The method used in this research is descriptive qualitative with written test and interview techniques. The result of this research is that there are difficulties in each group of students who have different academic abilities.

Keywords: Teacher Perception; Learning Difficulties

INTRODUCTION

Mathematics is a science that is systematically arranged, starting from undefined terms, continuing to defined terms, then to axioms / postulates until finally to theorems. According to Erman Suherman, et al (in Melinda Rismawati, 2018) mathematics is a science that is organized systematically and logically. K raft-concept in mathematics is arranged in a structured, hierarchical, systematic and logical, starting from the concept of the simplest to the concept of the most complicated. Ruseffendi in (Isrok'atun et al; 2020) states that mathematics is composed of undefined elements, definitions and axioms, as well as propositions in which these propositions apply in general after being proven true, therefore mathematics is called with deductive science. Meanwhile, James and James stated that mathematics is a science of logic related to forms, arrangements, concepts and quantities that are correlated with each other, divided into three fields, namely geometry, algebra and analysis (Sularningsih et al, 2018).

Bell (in Gazali, 2016) classifies objects in mathematics consisting of facts, concepts, skills and principles. Fact is a convention or agreement in mathematics, for example symbols in mathematics. While mathematical skills are a combination of operations and procedures where mathematicians are expected to solve problems quickly and precisely. Various skills are in the form of a certain sequence of procedures called algorithms. Concept is an abstract idea or idea that allows one to classify certain objects or events and it is also possible to determine whether certain objects or

events are examples or not examples of the idea. The principle is the relationship between shared concepts with the relationship between concepts.

To learn mathematics optimally, it is necessary to master the previous concepts which are prerequisites for the concepts to be studied. In learning mathematics the teacher starts by conveying or reminding the prerequisite material that must be mastered by students in order to be able to master the concepts to be studied starting from the simplest concepts to the most complex concepts.
In learning mathematics there are many things that cause students to experience difficulties. According to (Ismail, 2016:36) learning difficulties can be interpreted as the inability of students to complete the tasks given by the teacher or the inability of students to accept the material that has been delivered by the teacher. Understanding learning difficulties in general is a condition in the learning process which is characterized by the presence of obstacles in achieving the goals or learning outcomes set

Cahyono (2019) states that learning difficulties are a condition in learning that is characterized by certain obstacles to achieving learning outcomes. Broadly speaking, learning difficulties can be grouped into two (1) pre-academic learning difficulties and (2) academic learning difficulties (Marlina, 2019). Pre-academic learning difficulties experienced by children of pre-school age are experiencing deficiencies in the abilities that will later be needed to study academic subjects such as motor, perceptual, language, cognitive, and social skills. Academic learning difficulties indicate the existence of various failures in academic achievement in accordance with the expected potential. According to Marlina, learning difficulties are characterized by low achievement of learning outcomes for certain subjects while others are generally good.

Subini in (Farhan, 2019) said that the main factor in students' learning difficulties was internal factors, one of which was knowledge. According to Anderson (in Aini, 2015: 9) the dimensions of knowledge consist of factual knowledge, conceptual knowledge, procedural knowledge, and metacognitive knowledge.

According to (Suryaningsih, 2020) factual knowledge contains the basic elements that students must know if they are going to study a scientific discipline or solve problems in that discipline. These elements are usually in the form of symbols that contain important information. Factual knowledge is mostly at a relatively low level of abstraction.

Khamidah (2017) states that conceptual understanding is the understanding that a thorough about basic concepts of mathematics. The indicators of conceptual understanding include: (1) Students can understand mathematical concepts, operations, and relationships, (2) Students can mention the nature of mathematical principles and the relationship between them, (3) Students can make what can be considered examples and what cannot be considered examples of concepts, (4) Students can express concepts using shapes and graphics, (5) Students can model concepts and translate them into denotations and ideas.

Procedural knowledge according to (Khamidah, 2017) is knowledge of the steps that must be taken to solve a problem and being able to explain or justify one way of solving mathematical problems. The indicators of procedural knowledge include: (1) Students can determine the steps needed to solve a problem, (2) Students can sequence an action in solving problems, (3) Students can apply or use symbols, circumstances and processes for solving mathematical problems, (4) Students can explain or justify one way of solving a given problem.

Metacognition according to RH Bruning, GJ Schraw & RR Ronning (in Sholihah, 2016) is generally related to two dimensions of thinking. The first is the awareness that a person has about his or her thinking (self-awareness of cognition). The second is the ability of a person to use his consciousness to regulate his thought processes (self-regulation of cognition). Meanwhile, Huitt argued that metacognition includes a person's ability to ask and answer several questions related to the task at hand.

In learning mathematics, the experiences and conceptions (framework) of students need to be involved (Yusmin, 2017). If the teacher does not pay attention to the initial conception of students, the teacher will find it difficult to instill new concepts correctly. This will result in students having difficulty in learning or understanding mathematics. The difficulty of students learning mathematics at school varies greatly in terms of the object of study.

One of the branches in mathematics is geometry. Geometry is one of the important aspects in learning mathematics that must be understood by students, because the concept of geometry is very closely related to the context of everyday life (Rofii, Sunardi, & Irvan, 2018). According to Negoro & Harahap (in Novita. R, 2018) three-dimensional geometry is a part of geometry that discusses spatial or dimensional shapes. Building space can be defined as a shape that is not entirely located in the plane because it contains three elements, namely length, width, and height, or often referred to as three dimensions.

Three-dimensional geometry discusses objects that are abstract (Iswadji, 2001). These objects are points, lines, planes, cubes, blocks, spheres, and so on, all of which are objects obtained through an abstraction process based on concrete objects found in everyday life (Clements & Sarama, 2011; Couto). & Vale, 2014). Based on the Minister of Education and Culture No. 37 of 2018, one of the basic competencies that must be mastered by students in mathematics subjects related to three dimensions is to describe and determine distances in space (between points, points to lines and points to fields).

Based on field observations in class XII.IPA SMA Negeri 2 Banjar, learning on three-dimensional material related to distance in space has not yet achieved the learning objectives. While the core competencies that must be mastered by students in the field of knowledge in the 2013 Curriculum are 'understanding, applying, and analyzing factual, conceptual, procedural, and metacognitive knowledge based on their curiosity about science, technology, art, culture, and humanities with human insight. , nationality, state, and civilization related to the causes of phenomena and events, as well as applying procedural knowledge in specific fields of study according to their talents and interests to solve problems'. Based on this, there is a need for further research on the difficulties of students in three-dimensional material which causes learning objectives to not be achieved. Therefore, this study aims to determine the difficulties of class XII IPA SMAN 2 Banjar students in three-dimensional material based on Anderson's knowledge dimensions, namely factual, conceptual, procedural, and metacognitive knowledge.

RESEARCH METHODS

The method used in this research is descriptive qualitative research method. The data collection technique used is a measurement technique with written tests and interviews. The test used in this study is a test of the ability of students to solve problems regarding three-dimensional material related to distances in space (between points, points to lines, and points to planes). Measurement of students' ability to solve problems in this study aims to detect students' difficulties in the material based on the dimensions of Anderson's knowledge. The interview technique is delivered orally which is done by giving a set of questions or verbal statements in the form of dialogue. In this study, the interview technique was carried out after the students completed the test. Researchers will conduct structured and unstructured interview techniques in the form of open-ended questions. This is based on the research method used by the researcher, depending on the researcher's understanding of the data or information obtained from the results of the written test.

The research was carried out in odd semester learning with the research subjects being class XII students of SMA Negeri 2 Banjar in the 2021/2022 academic year. Subject selection was based on purposive sampling technique. The consideration in selecting the subject is having different academic abilities (high, medium, and low) and being able to communicate verbally well. The object of this research is the difficulty of students in three-dimensional material related to distance in space.

The data collection tool used in this study was in the form of a written test in the form of a description and interview guide. Data in the form of student answers were analyzed based on the dimensions of Anderson's knowledge, namely factual, conceptual, procedural, and metacognitive knowledge, so that information about students' difficulties in certain aspects of the Anderson knowledge dimension would be obtained.

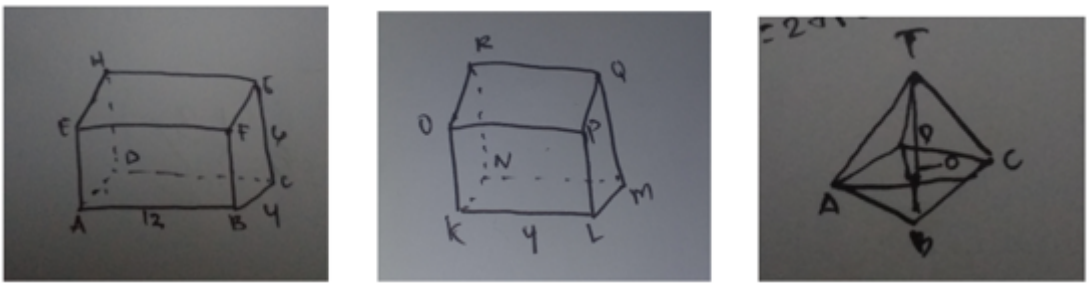
RESULTS AND DISCUSSIONS

Results

Based on the results of tests and interviews from 3 groups of research subjects, namely groups of students with high academic abilities, groups of students with moderate academic abilities and groups of students with low academic abilities, the following data were obtained.

1. Aspects of factual knowledge

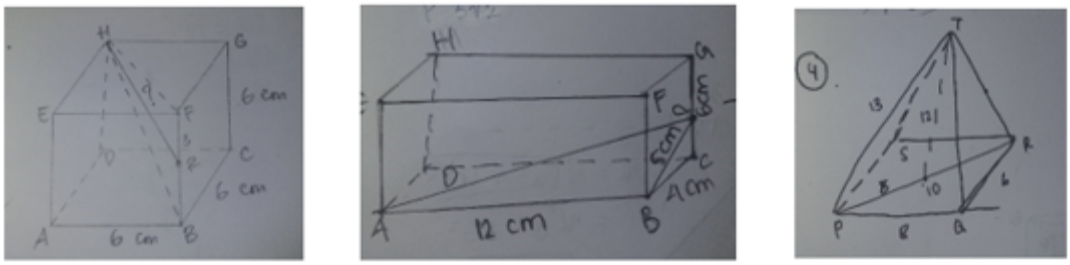
In the aspect of factual knowledge, difficulties are experienced by groups of students with low academic abilities. Students are not complete in writing down all the important information that is known in the problem. This can be seen in Figure 1a, students do not write down point P which is located in the middle of the CG edge, in Figure 1b students do not draw a diagonal OQ, and in Figure 1c students do not write down the elements that are known in the problem, namely the length of the base edge. 18 cm and 12 cm high.



Students with moderate and high academic abilities do not experience difficulties in the aspect of factual knowledge. Students write down all the important information that is known in the problem correctly. Figure 2 shows the answers of students who have medium and high academic abilities.

2. Conceptual knowledge aspect

In the aspect of conceptual knowledge there are several difficulties experienced by groups of students who have low academic abilities. Students have difficulty in choosing a triangle that is used to determine the distance from point to point, point to line or point to plane. Based on the results of interviews, students also have difficulty in determining the type of triangle that has been selected, whether the triangle is a right triangle, equilateral, isosceles or any triangle. In addition, students also have difficulty visualizing in the form of images to determine the distance from point to point, point to line and point to plane.



The picture above is the answer from students with low academic ability. In Figure 3a, students have difficulty in determining the line segment which is the distance from point P to the edge of TR. In

Figure 3b students have difficulty in choosing a triangle which is used to determine the distance from point O to the TBC plane. Meanwhile, the group of students who are academically capable are having difficulties with the material on distance from point to line and distance from point to plane. In the matter of distance from a point to a line, students assume that a line segment which is the distance from a point to a line always falls right in the middle of the line. So that students have difficulty determining the distance or line segment that is perpendicular if it turns out that the projection of the point is not exactly in the middle of the line. In the matter of distance from a point to a plane, students do not know the concept of distance from a point to a plane, so it is difficult for students to determine the distance from a point to a plane which is visualized in the form of pictures.

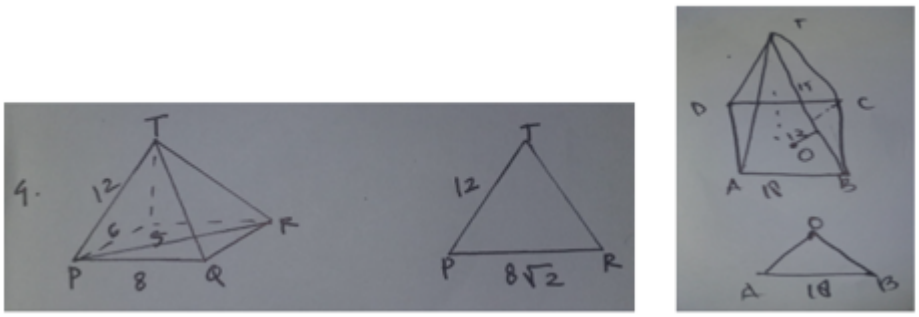


Figure 4a shows the answers to questions related to the material distance from the point to the line. The distance from point P to the edge of TR is indicated by PX, where based on the results of the interview, students assume that X is right in the middle of the edge of TR. This is wrong because PT and PR are not the same length, so X must not be exactly in the middle of the TR edge. In Figure 4b students have difficulty showing the line segment which is the distance from point O to the TBC plane.

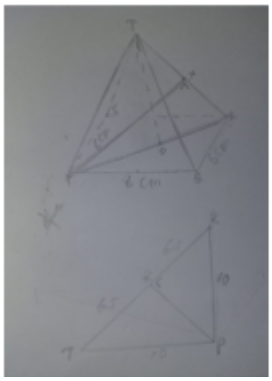
Learners with high academic abilities seen from the aspect of conceptual knowledge have difficulty in the distance material from point to field. Students understand the concept of distance from a point to a plane, but students in this group have difficulty determining the distance from a point to a plane because students find it difficult to choose a line segment that is perpendicular to the plane.

3. Aspects of procedural knowledge

From the aspect of procedural knowledge, groups of students with low academic abilities have difficulty in applying the formula for calculating distances in space. Students do not understand the Pythagorean formula or the formula for the area of a triangle used to calculate distances in space. In addition, students also experience many difficulties in calculations, because they do not master arithmetic operations, especially those related to the form of the square root. In Figure 6a it can be seen that the students did not write down the Pythagorean formula. From the results of interviews with students, information was obtained that students did not write down the formula because they did not understand the Pythagorean formula, so that in the completion step students immediately wrote down the numbers but could not explain the origin of the numbers. Furthermore, these students are also weak in arithmetic arithmetic operations, especially those related to the root form. It can be seen from the answer written that . In Figure 6b it can be seen that students have difficulty in writing the Pythagorean formula, so that in the next step students have difficulty finding the correct answer to the question. In Figure 6c, students understand the Pythagorean formula, but in the next step students have difficulty in performing arithmetic operations, especially those related to the root form, so that students also have difficulty in determining the correct answer to the question.

In the group of students with moderate academic ability, students have difficulty working on questions related to the distance material from the point to the line. Students have difficulty determining the

formula to use if the point projection on the line is not exactly in the middle of the line. Students only use the Pythagorean formula to calculate the distance from a point to a line. In addition to the Pythagorean formula, the formula for the area of a triangle should also be used. Students also have difficulty if the steps in the problem must use more than one formula. Students find it difficult to determine which formula should be used first. In the matter of distance from a point to a plane, students cannot determine the formula used because students do not understand the concept of distance from a point to a plane so that it is difficult to determine a line segment which is the distance from a point to a plane.



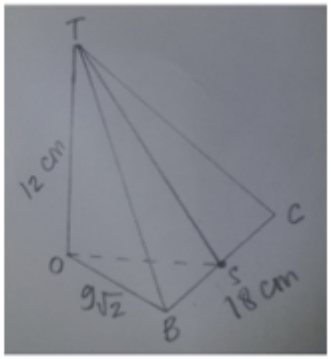
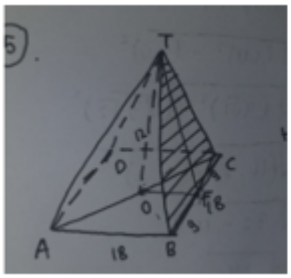
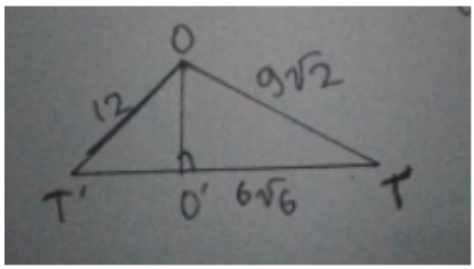


Figure 7a is the answer to a question related to the point-to-line distance material. It can be seen that these students have difficulty in determining the formula used in the completion step. Figure 7b is still related to the matter of the distance from the point to the line. In the last step, students find it difficult to continue their answers because students cannot determine the length of the RU. Students have difficulty determining the formula to use because the point projection on the line is not exactly in the middle of the line. Students only use the Pythagorean formula when it should also be possible to use the triangle area formula.

For groups of students with high academic abilities, having difficulty with the material on the distance from point to plane, Students understand the concept of distance from point to plane but have difficulty in choosing a line segment which is the distance from a point to a plane so that students are careless in applying the formula which should.





The picture above is the answer to a question related to the material distance from a point to a plane. In Figure 8a, students have difficulty continuing their calculations to determine the distance from a point to a plane. The steps used to determine the distance from a point to a plane are not precise. In Figure 8b students complete the answers to the last step, which is making conclusions from the results of the answers, but in the initial step students have difficulty in choosing the triangle used to determine the distance from the point to the plane, so that in the next step students are not right in applying the formulas. .

4. Aspects of metacognitive knowledge

To find out the difficulties of students in the aspect of metacognitive knowledge, apart from being seen from the results of the written test, an interview test was also conducted. Students answer the following questions.

- What do you know about three-dimensional matter (distance in space)?
- Do you think this material is quite difficult to understand?
- How long will it take to learn it?
- How did you get information about this material?
- What strategies or tactics did you use in studying this material to better understand the material, apart from reading the material presented by the teacher?
- Can you understand this material just by hearing, reading or seeing?

From the results of the interviews obtained information that for groups of students with low academic ability find it difficult to choose and use the right strategy in studying distance material in space. Students in this group need more time to learn the material compared to groups of students with moderate and high academic abilities.

CONCLUSIONS

From the results of the research and discussion above, it can be concluded that the difficulties faced by students in each aspect based on the dimensions of Anderson's knowledge are different for each group. So we need the right learning strategy so that every student with different academic abilities can study the material well and obtain maximum results. Alternative problem solving in overcoming students' difficulties on distance material in space, among others; 1) Before delivering the distance material in the room, the teacher needs to give a strong emphasis on the prerequisite material that must be mastered by students including the Pythagorean theorem, the area of a triangle and the concept of the position of points, lines and planes. 2) Teachers should use a constructivist approach in the learning process, by providing examples of concrete three-dimensional objects such as cubes, blocks and pyramids. Then students are asked to determine the desired distance using a measuring device such as a ruler or something else. After that, students are directed to measure the exact distance using a formula. The right approach can assist students in increasing factual and conceptual knowledge of distance material in space, 3) students are given a variety of practice questions to increase their procedural and metacognitive knowledge. In each question, it is necessary to practice the use of a coherent algorithm starting from what is known, asked and answered, then re-checked to ensure the accuracy of the answer

REFERENCES

Aini, S. J. (2015). *Identifikasi Dimensi Pengetahuan Yang Digunakan Peserta didik Dalam Menyelesaikan Masalah Matematika Ditinjau Dari Tingkat Kemampuan* (Doctoral dissertation, UIN Sunan Ampel Surabaya).

Cahyono, H. (2019). Faktor-Faktor Kesulitan Belajar Peserta didik Min Janti. *JDPP Jurnal Dimensi Pendidikan dan Pembelajaran*, *7*(1), 1-4.

Clements, D. H., & Sarama, J. (2011). Early childhood teacher education: The case of geometry. *Journal of mathematics teacher education*, *14*(2), 133-148.

Darimi, I. (2016). Diagnosis kesulitan belajar peserta didik dalam pembelajaran aktif di sekolah. *JURNAL EDUKASI: Jurnal Bimbingan Konseling*, *2*(1), 30-43Gazali, R. Y. (2016). Pembelajaran matematika yang bermakna. *Math Didactic: Jurnal Pendidikan Matematika*, *2*(3), 181-190.

Farhan, M. S., & Zanthy, L. S. (2019). Analisis kesulitan matematika peserta didik MA dalam menyelesaikan soal menggunakan taksonomi bloom. *JPMI (Jurnal Pembelajaran Matematika Inovatif)*, *2*(5), 307-314.

Isrokatun, I., Hanifah, N., Maulana, M., & Suhaebar, I. (2020). *Pembelajaran Matematika dan Sains secara Integratif melalui Situation-Based Learning*. UPI Sumedang Press.

Iswadji, D. (2001). Geometri ruang. *Universitas Negeri Yogyakarta: Jurusan Pendidikan Matematika*.

Khamidah, L. (2017, July). Pemahaman Konseptual Dan Pengetahuan Prosedural Peserta didik Kelas VIII Dalam Penyelesaian Soal Matematika Pada Materi Sistem Persamaan Linier Dua Variabel. In *Prosiding SI MaNIs (Seminar Nasional Integrasi Matematika dan Nilai-Nilai Islami)* (Vol. 1, No. 1, pp. 611-616).

Marlina, M. (2019). Asesmen Kesulitan Belajar.

Novita, R., Prahmana, R. C. I., Fajri, N., & Putra, M. (2018). Penyebab kesulitan belajar geometri dimensi tiga. *Jurnal Riset Pendidikan Matematika*, *5*(1), 18-29.

Rismawati, M., & Hutagaol, A. S. R. (2018). Analisis kemampuan pemahaman konsep matematika mahapeserta didik PGSD STKIP Persada Khatulistiwa Sintang. *Jurnal Pendidikan Dasar Perkhasa: Jurnal Penelitian Pendidikan Dasar*, *4*(1), 91-105.

Rofii, A., Sunardi, S., & Irvan, M. (2018). Characteristics of students' metacognition process at informal deduction thinking level in geometry problems. *International Journal on Emerging Mathematics Education*, *2*(1), 89-104

Sholihah, U. (2016). Membangun metakognisi peserta didik dalam memecahkan masalah matematika. *Ta'allum: Jurnal Pendidikan Islam*, *4*(1), 83-100.

Sularningsih, S., Battijanan, A., & Widodo, S. A. (2018, February). Analisis Kesalahan Dalam Menyelesaikan Masalah Matematika Dengan Menggunakan Langkah Poliya Peserta didik SMK. In *Prosiding Seminar Nasional Pendidikan Matematika Etnomatnesia*.

.Wahyuni, T. (2020). STUDI DIMENSI PENGETAHUAN DAN KUALITAS SISTEM: PENDEKATAN D&M IS SUCCESS MODEL (Studi Penggunaan e-SPT Orang Pribadi Pada KPP Kebon Jeruk Satu Jakarta Barat). *Jurnal Ekonomi Vokasi*, *3*(1), 66-77.

Yusmin, E. (2017). KESULITAN BELAJAR PESERTA DIDIKPADA PELAJARAN MATEMATIKA (RANGKUMAN DENGAN PENDEKATAN META-ETHNOGRAPHY). *Jurnal Visi Ilmu Pendidikan*, *9*(1).