DEVOTION Journal of Research and Community Service
Volume 4, Number 3, March 2023
e-ISSN: 2797-6068 and p-ISSN: 2777-0915

IDENTIFICATION OF STUDENTS' CONCEPTUAL AND PROCEDURAL ERRORS IN SOLVING PROBLEMS IN THREE-DIMENSIONAL MATERIAL

Wandy Suhady, **Yenita Roza, Maimunah**
Mathematics Education, Universitas Riau, Indonesia
Email: winaldi5784@gmail.com

KEYWORDS
Conceptual errors, Procedural errors, three dimension

ABSTRACT

Low math skills of students can be seen from the understanding and the assignment of students to a material. One of the clues to determine the extent to which students master the material is to analyze student's mistakes in working on. The study aims to describe the kind of conceptual errors and procedural errors in the student answered question on the three-dimesional material. This study used descriptive qualitative approach. This research subject is class XII IPA SMAN 1 Bengkalis. Techniques of data collection using interviews and documentation written test. The object of this study was grade XII IPA 1 SMAN 1 Bengkalis which amounted to 26 students. This research result is the kind of mistake that most people do students is a conceptual mistake in working on the three dimensional material is 52%. While its procedural errors as much as 48%. Conceptual errors and procedural errors occurred because of the low ability of abstraction and visual abilities in students in answering the questions that are hard to describe and determine the distance to a point on the field of three dimensional material. Low math skills of students can be seen from the understanding and the assignment of students to a material.

INTRODUCTION

The characteristic of mathematics is to have abstract objects of study, namely facts, concepts, operations and principles (Ananda et al., 2018). Errors of fact in mathematics include: symbols, notations and rules of an operation as well as errors in writing known and asked. Concepts include abstract ideas for classifying an object and explaining which are examples and not examples. Concepts in mathematics are a form of idea ideas related to the properties of an element (Zulfah, 2017). Operations in mathematics include the rules of working on a calculation. While the principle of mathematics is the relationship between several concepts in mathematics that are composed of facts and concepts related to operations in mathematics. On mathematics subjects all material have a relationship with each other. Mathematics is a structured science that requires basic knowledge which is a prerequisite for subsequent abilities. One of the mathematical materials in K13 is the triple dimension, especially in the distance sub-material between fields (Aisyah, 2019).

Three-dimensional material is difficult to understand because it is abstract and students' lack of ability to describe three-dimensional buildings (Novita et al., 2018). Problems in dimension three require not only skills (psychomotor) but also must have thinking and reasoning power. This is the cause of students' mistakes in answering three-dimensional questions (Alghadari et al., 2020). Students must be able to use abstraction skills in solving three-dimensional problems (Utari, 2019). The ability of abstraction in question is a person's ability to think logically using symbols (Yuniyanti, 2012). In addition to abstraction skills, it also requires visual skills or spatial abilities of students in answering questions on three-dimensional material. Visual (spatial) ability is the ability to imagine a shape of an object from different points of view in solving geometric problems of three dimensions, as well as the ability to manipulate and rotate from an element (Febriana, 2015). This is supported by an interview with a mathematics teacher at SMAN 1 Bengkalis. The teacher pointed out that it is often difficult for students to describe the point-to-line distance and the point-to-plane distance. The teacher stated that students do not master the steps of painting distances in space, opeconstellations of fractions and root shapes often occur miscalculations. Students also have difficulty understanding the axioms contained in dimension three.

Researchers also interviewed several students related to three-dimensional material. They revealed that it is difficult to imagine the process of determining the distance in space, students also often make miscalculations and do not understand the questions well. So from this problem, the researcher wants to identify the type of student error in solving the problem in the three-dimensional material. Researchers gave an initial identification test to students of SMAN 1 Bengkalis who had followed the three-dimensional material in the form of a description test. The given question is: A 16-rib long ABCD cube. Determine the distance of point A to BDE.

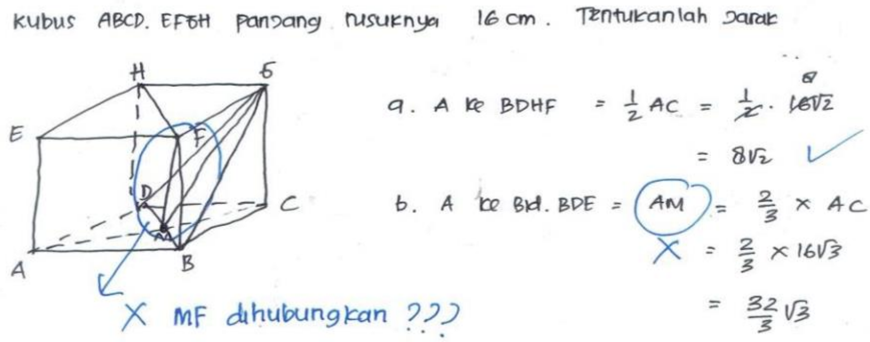


Figure 1. Student Answers To Question Number 1

The results of student work have not been able to describe the distance between a point and a field. The concept of the distance between point to field is not yet understood by students , this is illustrated by the steps in determining the distance of a point to a field that students do not work on. The error contained in this student's answer is a type of conceptual and procedural error. Students should understand the concept of point-to-plane distance , namely by determining the penetrating point of the point against the plane so that it isnot straight. The second problem is known to the ABCD cube. EFGH rib length 8 cm. Of course, the distance of point C to the AH line.

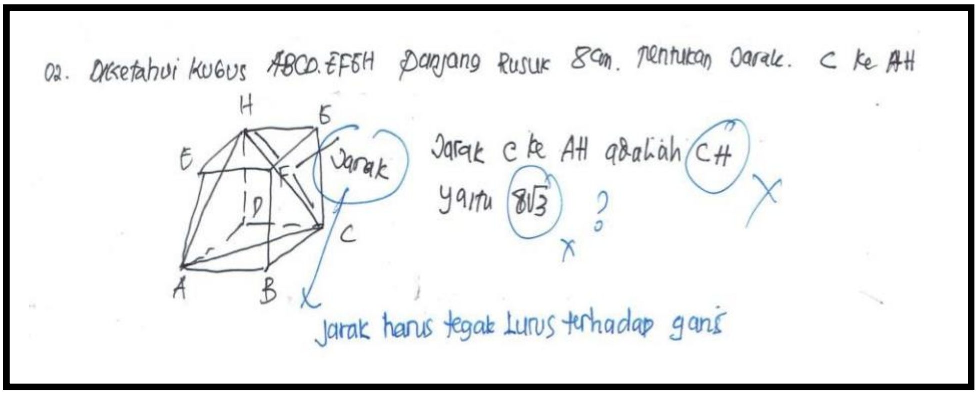


Figure 2. Student Answers To Question Number 2

It can be seen from the picture above that students cannot describe the distance of the point to the line. The step of the step to draw the distance of the point to the line has not been mastered by the student. Students tend to connect points to lines regardless of whether the line beam is perpendicular or not. Students also have a weak ability to relate the concept of the area of a triangle to determine the distance of a point to a line.

Tes initial identification and information from the teacher can be concluded that the student has difficulty dalam understanding the point-to-line distance and the point-to-plane distance so that the student makes a mistake . These errors include conceptual and procedural errors. The conceptual error intended here is that students have not been able to understand the concepts of point-to-line distance and point-to-plane distance in space. Meanwhile, the procedural error in question is that the student has not understood the step of determining and painting the distance between the point to the garis and the distance of the point to the plane in space.

Students' low mathematical ability can be seen from students' mastery of a material. One of them is by giving tests or questions about the material to students (Solfitri & Roza, 2015). To find out the mastery of the material, it is necessary to indetify students' mistakes in answering questions. Error identification is a diagnostic assessment in helping teachers recognize the types of mistakes made by students by giving reasons for a (Anggraini et al., 2018). Class identification can be done by observing the student's answer and then determining the type of mistake made by the student. In other words, the identification of errors can be done by relying on the criteria in afault analysis (Yusnia & Fitriyani, 2017). The purpose of identifying errors is so that there is an evaluation for educators to do a improvements in the teaching and learning process, for example using media to bridge abstract things in three dimensions so that they can be easily understood (Agustin & Linguistika, 2012).

Kurniasari (2013) stated that there are 3 student errors in doing geometry problems, namely: (1) abstraction errors, including: students' inability to abstract the determination of distance in the plane and angle between the line and the plane. (2) Procedural errors include the calculation of the root form and the use of the phytagoras formula. (3) Concepts include: errors in understanding the concept of distance, concepts of angles and errors in understanding right triangles in space. According to Hidayat et al (2013) who stated that students ' mistakes in answering three-dimensional questions are divided into 4 types, namely: (1) types of factual errors, namely students lack of scrutiny in completing the answer (2) type of misconception, namely the occurrence of student misconceptions regarding the distance of two parallel lines in space (3) type of operation error, namely students do not understand in squaring the shape of the root fraction, the summation of the shape of the root and the addition and division of the form of fractions (4) Types of principle errors i.e. the swa never does the type of story question about the angle between the two fields, so in the process of identifying the question until the student's final answer made a mistake.

Based on the opinions above, according to researchers, mathematical errors are categorized into 2 types, namely conceptual and procedural errors. Conceptual errors are mistakes made by students in interpreting terms, facts, concepts and principles. Procedural errors are errors in drawing up systematic steps to answer a problem. The purpose of this study was to identify the types of conceptual and procedural errors of students in solving the problem of distance in space in class XII of SMAN 1 Bengkalis.

RESEARCH METHOD

The research implemented at SMAN 1 Bengkalis with subject research be 26 student. Technique Collection data Consists above test Written, interview and documentation. Instruments thatUsed at research .ini be test Written and Researchers as instrument main. Deep test Validity data so Done technique Trianggulation method that is look for consistency data result test and interview. According to Miles and Entertain deep (Hanifah, 2014) to Determine error Done with analysis data that Done Refers at Reduction data Serving data and conclusion. To understanding procedure research so Researchers make design research as next.

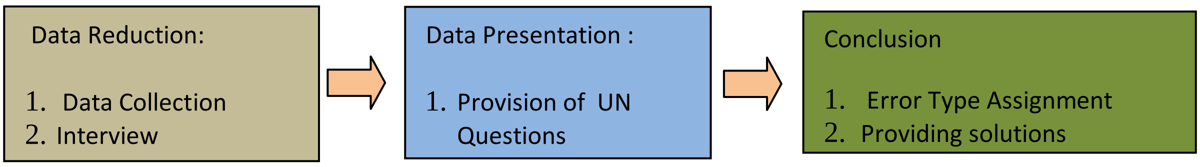


Figure 3. Research Design

Students' difficulty in answering three-dimensional material questions. At this stage also the researcher provides an initial diagnostic test to support the information from the researcher's interview with the teacher. At the stage of presenting data, the researcher provides a description test in the form of 4 UN questions in accordance with the indicators that have been made by the researcher. Researchers examine students' answers and then provide scores based on scoring guidelines. At the conclusion stage, researchers group the types of student errors, namely conceptual and procedural, and then analyze the errors. In addition to being analyzed, researchers provide solutions to solve problems faced by students in answering questions in three-dimensional material.

RESULT AND DISCUSSION

The presentation of data from student test results to determine student errors in three-dimensional material is described in the following table.

Table 1. Percentage of True and False Answers from Test Results

No	Number of Students Who Answer Correctly	Percentage (%)	Number of students who answered incorrectly	Percentage (%)
1	22	84.6	4	15.4
2	18	69.2	8	30.8
3	12	46.2	14	53.8

4	8	30.8	18	69.2

The test results from the table above illustrate that the most students answered incorrectly on question number 4, namely 18 students with a percentage of 69.2%. Question number 4 has a competency achievement indicator (GPA) determining the slice of the building space through the ui point. Question Number 1 is the most answered correctly by students , with 22 students answering correctly with a percentage of 84.6%. So the questions related to the slice of building space are the most difficult questions for students.

After getting various mistakes made by students such as table 1. Furthermore, the grouping of errors was made in percentage numbers of 26 students. Those percentages are presented in the following table.

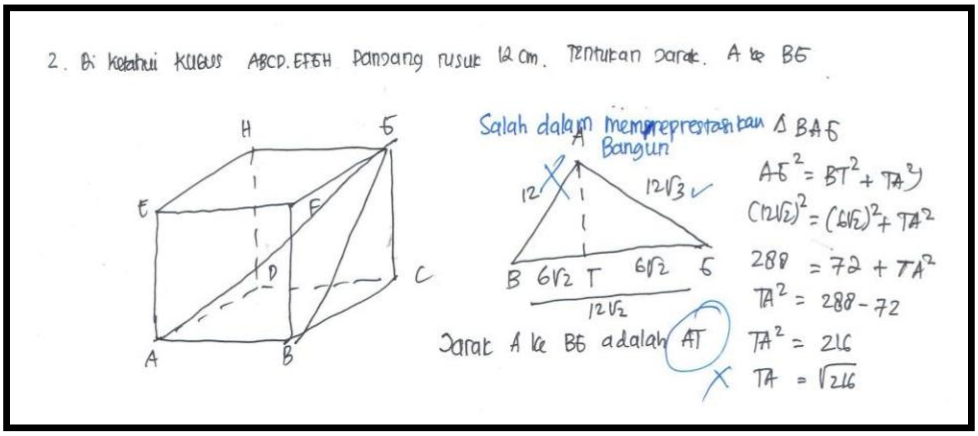
Table 2. Student Error Percentage By Error Type

No Problem	Misconceptions	Procedural Errors
1	10.34	6.67
2	20.69	13.33
3	27.59	40.00
4	41.38	40.00
Sum	100.00	100.00

Students make a lot of misconceptions on determining the slice of the space. It can be seen that question number 4 has the most misconceptions by students, namely 41.38%. As for procedural errors, the most occurs in questions number 3 and 4, which are 40% each. This suggests that students make a lot of mistakes on the question of point-to-field distance procedures and space building wedges. In addition, students do not understand the concept of drawing the expansion of lines and planes in a space. There are frequent misconceptions in connecting points in one plane. Students tend to connect two dots that are not a plot. Students also lack understanding of the concept of the affinity axis in helping to paint a space. For procedural errors students do not understand the steps in painting the distance of points to planes so there are often errors in painting orthogonal translucent points to the field. After calculating student errors, the next analysis of the types of student errors is carried out, namely conceptual and procedural errors. This analysis was carried out for students who did not reach KKM, namely 77.

Conceptual Error

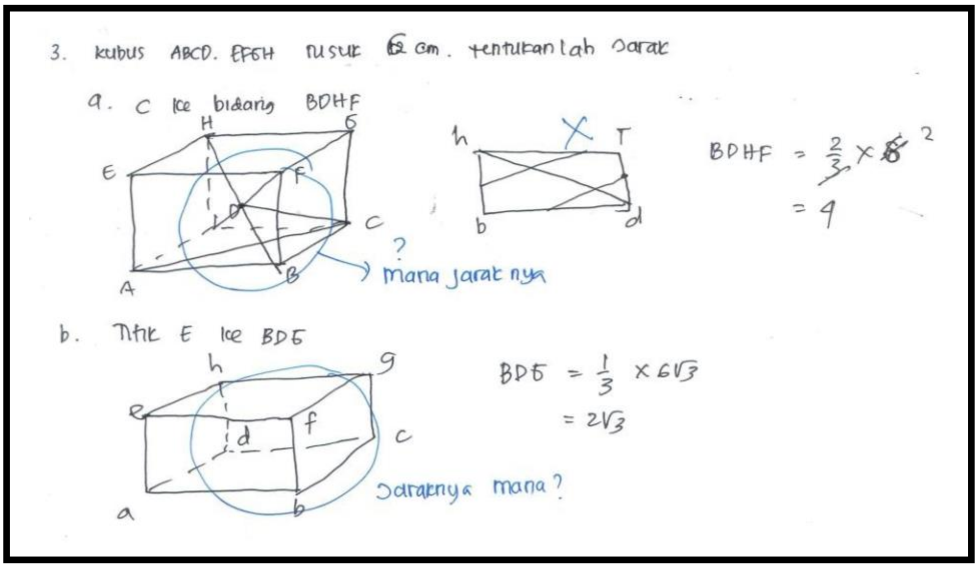
The figure below is a form of conceptual error made by students in answering question number 2



Figures 4. Examples of Student Mistakes on Question Number 2

The conceptual error seen from the student's answer above is that the student is wrong in determining the distance of the point to the line. Students use a triangular approach to determine their distance. Students create a distance from point A to BG by creating an ABG triangle then project point A right in the middle of the base of the BG triangle. If you look at the computational segi students can already operate ranked numbers and are already able to use the phytagoras theorem. Students should understand the concept of point-to-line distance, which is the distance of a point to a perpendicular (orthogonal) line when the point is illuminated by the line.

Ability Abstraction deep Determine distance point to line still weak for student. Student notunderstand in a comprehensive understanding light that upright straight towards a line. Debilitatin. Another student is that students do not understand the approach that needs to be used in solving in determining the distance of a point to a line. Almost all students answer this question using the triangle approach and Phytagoras theorem even though students can use it directly if they understand the concept of point-to-line distance. Another conceptual error is seen in the students' answers in answering question number 3.



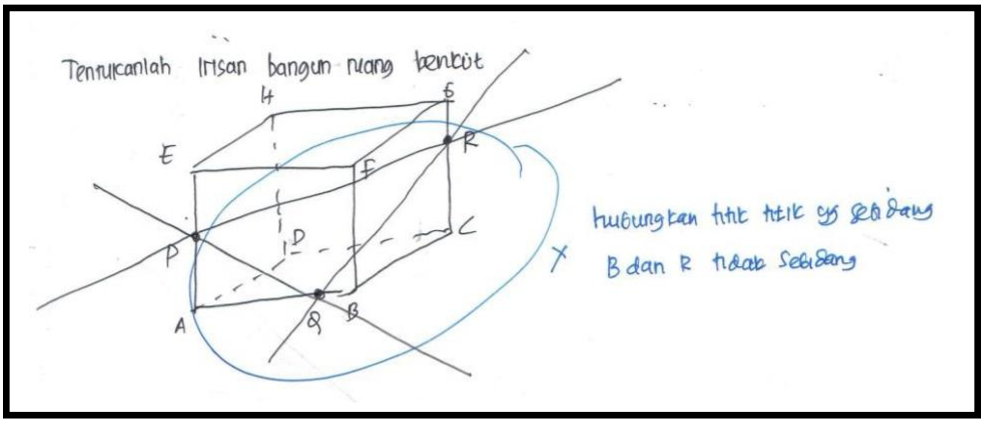
Figures 5. Student Answers to Question number 3

For question number 3a determining the distance of point C to the BDHF field, students have an error in painting the distance of point C to the BDHF field. Students assume the distance of point C to the BDHF field is C to the middle of HB. The computational process is also a problem for students. Students consider HD to be the diagonal of space and HB as the side of the cube. Most students are wrong in representing the field taken to determine the distance of the point to the field. Students should first create a BDHF field and project a C point onto the field BDHF with manner join point C to point A.

Question number 3b, students cannot paint the distance of point E to the BDG field. Direct students replied that the distance of the point E to the BDG plane is [1] of the diagonal length of the space. Student must paint the translucent point of the point E into the plane of the orthogonal BDG, by connecting the point E to C and connecting the midpoint of the BD e.g. point O to point G. Furthermore the intersection between the OG and EH lines it is the distance between the point E to the BDG plane. Most students who do not reach KKM aredoing the same thing. Students are unable to paint distances between a point and a plane. So the researcher concluded students' visual and abstraction skills are still lacking and the understanding of the concept of point-to-field distance has not been well understood by students.

Procedural Errors

The figure below is a form of conceptual error made by students in answering question number 2



Figures 6. Student Answers to Question

Students' answer at above show that student less understand steps deepDetermine Slices wake up room that Formed by point P, point Q and point R. Student direct join third point aforementioned and direct conclude that field such is the that become Slices triangle. Student join two fruit point that not a plot that is point P andpoint R. To point P and point Q student already true because dots aforementioned a plot. Then student also doubtful deep paint Expansion lines and field. Student not use Approach axis Affinity deep Determine slicean wake up room. Whereas Approach .ini very important to help Depicts Slices wake up room. Should student must understand step- step deep paint Slices wake up room Including; (1) connecting dots that are a plot, (2) expand lines and fields as needed, (3) painting the axis of affinity< and (4) painting slices of wake up space. Researchers see that students' abstraction and visual abilities are still low. It is seen that most students are not able to paint ruang wake slices. So there is a procedural error because it does not follow the steps in describing the slices of the building.

CONCLUSION

Based on the description that has been previously presented and the results of the analysis of student errors in doing questions on the third dimension material, it is concluded that the mistakes made by students include, namely Conceptual errors are the most common type of mistake made by students in answering three-dimensional material questions, which is about 52%. Conceptual errors and Procedural errors occur due to the low abstraction ability and visual ability of students. The ability to abstraction and visual ability in question is the ability to see abstract objects and represent those abstract objects into a flat plane.

A suggestion that can be used to overcome mistakes made by students in solving problems in three-dimensional material is that teachers should use learning media to build abstraction knowledge. students and guide students in doing questions on the third dimension material. Then for the next researcher to be able to identify the type of student error from the type of computation and principle. The goal is to be more specific in analyzing the mistakes made by students.

REFERENCES

Agustin, K., & Linguistika, Y. (2012). Identifikasi kesalahan siswa kelas X pada evaluasi materi sifat-sifat bilangan berpangkat dengan pangkat bilangan bulat di SMA Muhammadiyah 2 Yogyakarta. *Seminar Nasional Matematika Dan Pendidikan Matematika Di Jurusan Pendidikan Matematika FMIPA UNY.(Online). Eprints. Uny. Ac. Id/8097/1/P-50. Pdf. Diakses*, *20*.

Aisyah, F. N. K. (2019). *Analisis Kesalahan Peserta Didik dalam Menyelesaikan Soal Cerita Matematika Berdasarkan Kriteria Watson*. Universitas Kanjuruhan.

Alghadari, F., Herman, T., & Prabawanto, S. (2020). Factors affecting senior high school students to solve three-dimensional geometry problems. *International Electronic Journal of Mathematics Education*, *15*(3), em0590.

Ananda, R. P., Sanapiah, S., & Yulianti, S. (2018). Analisis kesalahan siswa kelas VII SMPN 7 Mataram dalam menyelesaikan soal garis dan sudut tahun pelajaran 2018/2019. *Media Pendidikan Matematika*, *6*(2), 79–87.

Anggraini, M. V., Sulandra, I. M., & Susiswo, S. (2018). *Identifikasi kesalahan soal sistem persamaan linear-kuadrat dua variabel*.

Febriana, E. (2015). Profil kemampuan spasial siswa menengah pertama (smp) dalam menyelesaikan masalah geometri dimensi tiga ditinjau dari kemampuan matematika. *Jurnal Elemen*, *1*(1), 13–23.

Hanifah, A. N. (2014). Penggunaan Scaffolding untuk Mengatasi Kesalahan Siswa Kelas VII H SMP Negeri 2 Mojokerto dalam Menyelesaikan Soal Cerita pada Materi Persamaan Linear Satu Variabel. *MATHEdunesa*, *3*(3).

Hidayat, B. R. (2013). *Analisis kesalahan siswa dalam menyelesaikan soal pada materi ruang dimensi tiga ditinjau dari gaya kognitif siswa (penelitian dilakukan di SMA Negeri 7 Surakarta kelas X tahun ajaran 2011/2012)*.

Kurniasari, I. (2013). Identifikasi Kesalahan Siswa dalam Menyelesaikan Soal Geometri Materi Dimensi Tiga Kelas XI IPA SMA. *Prosiding Seminar Nasional Matematika Dan Pendidikan Matematika FMIPA UNY*, *329*.

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.

Solfitri, T., & Roza, Y. (2015). Analisis kesalahan dalam menyelesaikan soal-soal geometri siswa kelas IX SMPN se-kecamatan tampan pekanbaru. *SEMIRATA 2015*, *1*(1).

Utari, E. D. (2019). *Analisis Kesalahan Siswa Berdasarkan Watson's Error Category dalam Menyelesaikan Soal Model PISA Ditinjau dari Gaya Kognitif Field Dependent-Field Independent*. UIN Sunan Ampel Surabaya.

Yuniyanti, E. D. (2012). *Pembelajaran Kimia Menggunakan Inkuiri Terbimbing dengan Media Modul Dan E–Learning Ditinjau dari Kemampuan Pemahaman Membaca dan Kemampuan Berpikir Abstrak (Pembelajaran Kimia Pada Materi Pokok Kesetimbangan Kimia Kelas XI IPA Di SMA Negeri*. UNS (Sebelas Maret University).

Yusnia, D., & Fitriyani, H. (2017). Identifikasi kesalahan siswa menggunakan Newman's Error Analysis (NEA) pada pemecahan masalah operasi hitung bentuk aljabar. *Prosiding Seminar Nasional & Internasional*.

Zulfah, Z. (2017). Analisis kesalahan peserta didik pada materi persamaan linear dua variabel di kelas VIII mts negeri sungai tonang. *Jurnal Cendekia: Jurnal Pendidikan Matematika*, *1*(1), 12–16.

Agustin, K., & Linguistika, Y. (2012). Identifikasi kesalahan siswa kelas X pada evaluasi materi sifat-sifat bilangan berpangkat dengan pangkat bilangan bulat di SMA Muhammadiyah 2 Yogyakarta. *Seminar Nasional Matematika Dan Pendidikan Matematika Di Jurusan Pendidikan Matematika FMIPA UNY.(Online). Eprints. Uny. Ac. Id/8097/1/P-50. Pdf. Diakses*, *20*.

Aisyah, F. N. K. (2019). *Analisis Kesalahan Peserta Didik dalam Menyelesaikan Soal Cerita Matematika Berdasarkan Kriteria Watson*. Universitas Kanjuruhan.

Alghadari, F., Herman, T., & Prabawanto, S. (2020). Factors affecting senior high school students to solve three-dimensional geometry problems. *International Electronic Journal of Mathematics Education*, *15*(3), em0590.

Ananda, R. P., Sanapiah, S., & Yulianti, S. (2018). Analisis kesalahan siswa kelas VII SMPN 7 Mataram dalam menyelesaikan soal garis dan sudut tahun pelajaran 2018/2019. *Media Pendidikan Matematika*, *6*(2), 79–87.

Anggraini, M. V., Sulandra, I. M., & Susiswo, S. (2018). *Identifikasi kesalahan soal sistem persamaan linear-kuadrat dua variabel*.

Febriana, E. (2015). Profil kemampuan spasial siswa menengah pertama (smp) dalam menyelesaikan masalah geometri dimensi tiga ditinjau dari kemampuan matematika. *Jurnal Elemen*, *1*(1), 13–23.

Hanifah, A. N. (2014). Penggunaan Scaffolding untuk Mengatasi Kesalahan Siswa Kelas VII H SMP Negeri 2 Mojokerto dalam Menyelesaikan Soal Cerita pada Materi Persamaan Linear Satu Variabel. *MATHEdunesa*, *3*(3).

Hidayat, B. R. (2013). *Analisis kesalahan siswa dalam menyelesaikan soal pada materi ruang dimensi tiga ditinjau dari gaya kognitif siswa (penelitian dilakukan di SMA Negeri 7 Surakarta kelas X tahun ajaran 2011/2012)*.

Kurniasari, I. (2013). Identifikasi Kesalahan Siswa dalam Menyelesaikan Soal Geometri Materi Dimensi Tiga Kelas XI IPA SMA. *Prosiding Seminar Nasional Matematika Dan Pendidikan Matematika FMIPA UNY*, *329*.

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.

Solfitri, T., & Roza, Y. (2015). Analisis kesalahan dalam menyelesaikan soal-soal geometri siswa kelas IX SMPN se-kecamatan tampan pekanbaru. *SEMIRATA 2015*, *1*(1).

Utari, E. D. (2019). *Analisis Kesalahan Siswa Berdasarkan Watson's Error Category dalam Menyelesaikan Soal Model PISA Ditinjau dari Gaya Kognitif Field Dependent-Field Independent*. UIN Sunan Ampel Surabaya.

Yuniyanti, E. D. (2012). *Pembelajaran Kimia Menggunakan Inkuiri Terbimbing dengan Media*

Modul Dan E–Learning Ditinjau dari Kemampuan Pemahaman Membaca dan Kemampuan Berpikir Abstrak (Pembelajaran Kimia Pada Materi Pokok Kesetimbangan Kimia Kelas XI IPA Di SMA Negeri. UNS (Sebelas Maret University).

Yusnia, D., & Fitriyani, H. (2017). Identifikasi kesalahan siswa menggunakan Newman's Error Analysis (NEA) pada pemecahan masalah operasi hitung bentuk aljabar. *Prosiding Seminar Nasional & Internasional*.

Zulfah, Z. (2017). Analisis kesalahan peserta didik pada materi persamaan linear dua variabel di kelas VIII mts negeri sungai tonang. *Jurnal Cendekia: Jurnal Pendidikan Matematika*, *1*(1), 12–16.