

Description of the Difficulties of Mathematics Education Students in Complex Analysis Course

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Abstract

This study is to determine the location of the difficulty of complex variable courses. Complex variable courses require a strong understanding, high concentration, good learning readiness, reasoning power and higher order logic in understanding direct objects. The direct objects referred to are Facts, Concepts, Skills, and Principles. In addition to direct objects in obtaining maximum results, indirect objects are needed. Indirect objects that are meant are tools used in the form of media, support and encouragement from others in obtaining good results. The results of the mid-semester grades for the 2014/2015 academic year were about 13% of students who got good grades and the rest were not good. In fact, this complex variable course is the main course of several courses. Another fact is that in the 2019/2020 semester VII, there are 35% in the poor category and 50% sufficient and the rest are good and very good. From 35% of students with poor learning outcomes took remedial, 1 person graduated with sufficient marks, while the rest did not pass. The specific objectives of the research are 1) to determine the mastery in complex variable courses, 2) the location of the difficulty and difficulty factors of complex variables, 3) to know the mastery and difficulty of indirect objects. This type of research approach is descriptive qualitative. Research wants to describe and describe how the actual event. The research was conducted in the Complex Variable Analysis course, Semester VII, implementation October-January and a total of 12 subjects. Techniques for obtaining data from observations, interviews and documentation. The analysis technique, presenting data, reducing and drawing conclusions. Conclusion, The difficulty of students lies in the facts and concepts that exist in the direct object. In the interview session, 71.42% said that the difficulty factor was the mastery of facts and concepts. In online implementation, students experience percentage difficulties when writing symbols and operating the media used. This is a new problem for mathematics students in achieving good learning outcomes with objective assessment standards.

Keywords: difficulty description; complex variable; complex analysis course.

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1. Introduction

Everyone has the right to education, because education is a necessity and a spirit of community, nation and state life. In this case, education needs a conscious effort from humans to develop personality, character and abilities in accordance with developed and cultured values. (Setiawan 2016). Until now, there are still many higher education institutions that emphasize knowledge as much as possible to students rather than exploring the skills and concepts that students need. (Binsen Samuel Sidjabat 2019). Mathematics is the most important science in education. A person's success in learning mathematics can be measured by the extent to which students can understand, explain, give examples and participate in these activities. The success of learning can also be seen from the level of understanding and mastery of the learning material (Anderha and Maskar 2021). However, in reality students must be aware that there are 2 indicators of mastery in mathematics, namely direct objects and indirect objects (Astuti 2020). Courses that often require direct object understanding and indirect object support so that mathematics education students pass are complex variable courses. Complex variable is a branch of mathematics that deals with the set of real numbers, functions in real numbers and imaginary numbers. Complex variable analysis can be called the deepest branch of mathematics, because in the material it discusses more deeply about direct and indirect objects. In studying complex variables, there are courses that are prerequisites, namely basic mathematics, basic calculus, advanced calculus, linear

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algebra, algebraic structures, real analysis, set theory, discrete mathematics, transformations, probability theory and differential equations. (Mandasari, Rahmadhani, and Wahyuni 2020).

The complex variable is the parent of Mathematics education courses and are mandatory for students to take. Studying the complex variable analysis course requires a strong understanding of the previous courses, high concentration, good learning readiness, high reasoning power and logical thinking. Therefore, many students think that Variable Analysis is a difficult subject (Mandasari, Rahmadhani, and Wahyuni 2020). Things like this can have an impact on achieving less than optimal student learning outcomes. One of the materials in complex variable analysis is the real number system. according to (Karimah and Setiyani 2019) The real number system is an algebraic system in which the operations of addition (+) and multiplication operations (x) have the following properties: (R,+) Commutative group, (R-{0}, Commutative group, (R,+,) distributive real number system discusses algebraic properties, order properties and absolute values, and completeness properties (Widodo, Santia, and Jatmiko 2019) the percentage of student learning outcomes of the Mathematics Education Study Program in the 2015/2016 Academic Year in the Real Analysis course was only 32.4% of students who got sufficient marks. These results are used as a basis for measuring the extent to which students understand direct objects and indirect objects in the material and what difficulties are experienced in obtaining learning outcomes. Analysis of complex variables. There are still many Middle Semester Exams (UTS) for the Mathematics Education Study Program that have not achieved the criteria for a good score, namely B or around 63 Scores of 70. The results of the Mid-Semester Examination (UTS) for the 2014/2015 academic year are around 13% of students who get good grades. In fact, this complex variable course is one of the core courses in mathematics education. Another fact is that in the Mathematics Education Study Program in the 2019/2020 semester VII, there are 35% in the poor category and 50% sufficient and good. From 35% of students with poor learning outcomes took remedial and 25% graduated with sufficient and good grades, while another 10% did not pass and had to repeat in the next semester because the criteria for passing grades ranged from 55 Value 65. Learning difficulties are a condition where students cannot understand direct objects and indirect objects in mathematics.

According to (Anugrahana 2021) The difficulty experienced when learning mathematics is a weakness in understanding and proving direct objects. Difficulty in recognizing facts, skills, concepts and principles. People who study mathematics must be able to show the four things that are in the direct object. As with complex variable analysis courses, students must be able to show real concepts in everyday life which are called facts. Errors in mentioning facts, lack of ideas or concepts, sufficient skills in proving and correcting questions are very dominant things faced by students and teachers themselves. In research (Lumbantoruan and Male 2020), 62% of teachers admit weaknesses in Professional competence. Whereas in professional competence, a teacher has to master and be able to show examples of facts, skills, concepts and principles that exist in direct objects and tools in indirect objects. Difficulties in conveying ideas or transferring knowledge in connecting complex variable concepts with existing realities are basic things that must be mastered by students. The learning difficulties experienced by students are very diverse, the difficulties experienced in general in mathematics or in mathematics education courses are caused by two factors and can hinder the student's learning process. (Lumbantoruan 2019) Factors causing learning difficulties consist of 2 kinds, namely students' internal factors: 1) cognitive (facts, concepts and principles) and 2) psychomotor (skills). While the external factors of students are: (1) the media used, friends, community and family and the environment. Basically, the learning difficulties experienced by students can be described in many ways, through errors when students explain the material, when writing, when proving theorems and when working on problems. Students who experience errors, it is certain that students have difficulty understanding the material. The influence of using technology in the process of online learning throughout Indonesia adds new impacts and difficulties in understanding mathematics material (Watnaya et al. 2020). It takes special skills or mature skills to use the media in explaining and showing the direct objects that exist in each complex variable material. Yensy (2020) in research on the description of difficulties in solving math problems. There are 4 types of difficulties in the learning process of mathematics experienced by students, namely conceptual difficulties, facts difficulties, operations difficulties, and principle difficulties. Amalia and Hadi (2020) in the research description of students' learning difficulties in mathematics in terms of cognitive style with the Think Pair Share (TPS) learning model. Students who have a Field Dependent cognitive style have difficulty recognizing and understanding symbols and subjects with a Field Independent cognitive style having language and reading difficulties. In mathematics, there are various topics that are related to each other. Not only the relationship between topics and topics, but also between disciplines in everyday life (Arfinanti 2020). Everyone who studies mathematics must be able to link facts, concepts, principles and skills. In general, every student who graduates from mathematics education must master 4 indicators, namely facts, skills or skills, concepts or ideas and principles.

1.1. Research Problem Formulation

- 1) How is the student's mastery of complex variable material?
- 2) How difficult is it for students to understand complex variable material?
- 3) How is the student's mastery of indirect objects?

1.2. Research purposes

- 1) To find out how students mastery in complex variable courses
- 2) For the location of the difficulties and factors of students' difficulties in understanding complex variables.
- 3) To know the mastery and difficulty of indirect objects.

2. Literature Review

2.1. Definition of Complex Variable

Complex Variables and their Algebra have different meanings but are mutually continuous or related because they are related to complex variables. Complex numbers are defined as "ordered pairs" of real numbers from two real numbers.(Yuninda 2007) Whereas in the differential equation is a mathematical equation for the function of a variable or more, which relates the value of the function itself and its derivatives in various orders.(Program et al. nd). A number is said to be a complex number if $z = (x, y) = x + yi$, geometrically expressed as follows, is a complex number (Cartesian), which is an ordered number. Thus all complex numbers can be represented by all points on a Cartesian number or an ordered number. The set of all these pairs with certain appropriate operations can be defined as a complex number system. x, y (Yuninda 2007). Note: there is no specific reason for using to represent domains, result areas, and functions. Many other letters can be used. It is generally used to denote the independent domain (or related/dependent variable. x, y , dan $f x, y$, dan f (Hamza 2020). Definition of Complex Numbers Include: Complex Number Notation, Arden Diagram, Other forms of $E = x + iy$, Complex Algebra, Determining $n = \text{Integer}(i^n)$, Complex Numbers Addition Operation, Complex Consignate, Multiplication Operation. Definition of Complex Number Geometry, Modulus (Absolute Value) of Complex Numbers, Polar (Polar) and Exponential Forms

2.2. Indicator of Difficulty in Studying Complex Variable Subjects

Lumbantoruan and Natalia (2021) argues that difficulties during the learning process are conditions that should be conducive learning situations and have good initial abilities. Alyaa, Krisdianto Hadiprasetyo, and Annisa Prima Exacta (2020) argues a situation where students experience obstacles from certain factors in understanding one material. Yasin and Netriwati (2019) there are quite a number of learning difficulties that can hinder the learning process of mathematics, including: 1) not mastering basic concepts; 2) do not know the purpose of the material and questions; 3) difficult to form mathematical models; 4) difficult to complete mathematical sentences; 5) lack of accuracy; 6) mistakes in writing numbers. Suryani, Pendi, and B. Seto (2020) difficulties in learning mathematics in students, namely; 1) presence of spatial disturbances, 2) abnormalities of visual perception, 3) visual-motor associations, 4) perseveration, 5) difficulty understanding symbols, 6) impaired body appreciation, 7) difficulties in language and reading, 8) significantly higher Performance IQ scores lower than the Verbal IQ score. Meanwhile, according to Asih (2019) In mathematics, there are two things that must be mastered, namely direct objects and indirect objects. In this study, two indicators were used to detect the difficulties of the student learning process.

2.3. Direct Objects and Indirect Objects

A prospective teacher or even a teacher must know the object of mathematics. Mathematical objects are objects that are real or tangible that are easy to find in everyday human environments and are silent among us. Land stakes, mapping of rice fields, fences, distance from door to window and so on. Mathematics develops into something abstract and imaginative and axiomatic called complex. There are two indicators that become a benchmark for mathematical difficulties inherent in the professional competence of prospective teachers or those who have become mathematics teachers, including direct objects and indirect objects. Direct object. Facts are agreements made by

experts through agreements that have been agreed unanimously, whether in symbols or numbers "5" "five", "α" "alva", facts: "+" addition operation, Sine is a special function in trigonometry. $2+2 = 4$ and $5 - 4=1$ are examples of agreed facts. Concepts are ideas that are imaginative and have directions and goals that can be actualized by examples and not examples. Like cubes, triangles, cubes, plane figures, space figures, sets, and radii are concepts in mathematics. The activity of the learning process in understanding one material is not just sitting in the classroom but out of the real world, namely the natural surroundings, so as to be able to understand mathematical concepts through daily activities. In everyday life is able to make mathematics students get a variety of new information. So that students will see patterns, relationships between various knowledge inherent in mathematics. Daily activities are sufficient to foster an understanding of mathematical concepts. Such as defining a trapezoid, the definition of a cube, the definition of a tube, a triangle and so on(Andayani and Amir 2019). The principle is the most complete and complex object and has axioms. A collection of several concepts that have a definite purpose and direction. For example, two triangles are congruent and congruent if the two sides and the enclosed angles are congruent. Principles also include theorems and postulates. Skill or Skill is someone who has advantages and speed in providing correct and precise answers to what is expected of the question. For example, definite integrals, trigonometric substitution integrals and so on.

2.4. Indirect object

Derivatives of good behavior and character as well as discipline such as attitude, ability to design ways towards a goal (positive), build communication by achieving a goal (positive), good mentality, being honest in the sense of admitting weaknesses, preparing materials with the essence of the value of good learning outcomes (positive).Evianti, Jafar, and Masi (2019)which says that the teacher takes the role of a facilitator and as an obligatory person in terms of fostering students in a better direction, his main task and first of all an educator is to teach, educate, guide, train and assess and the last is evaluate.Kartini and Kristiawan (2019)The three main tasks of the teacher are professional, social and human tasks. The teaching profession is forced and required to be professional in developing knowledge in a sustainable manner in stages. Teachers are also required to be able to develop their knowledge and incorporate it into technology that can be used as a medium in delivering teaching materials. Teachers are also required to have general skills and special skills in choosing methods and detecting difficulties faced by students, both from the educator and from outside.(2019 function). Every educator or student has experienced difficulties in certain cases, this is a factor from himself or from outside. Internal factors are lack of motivation for the profession and obligations as educators. Factors come from outside. As a professional educator, you must be supported by the surrounding environment.

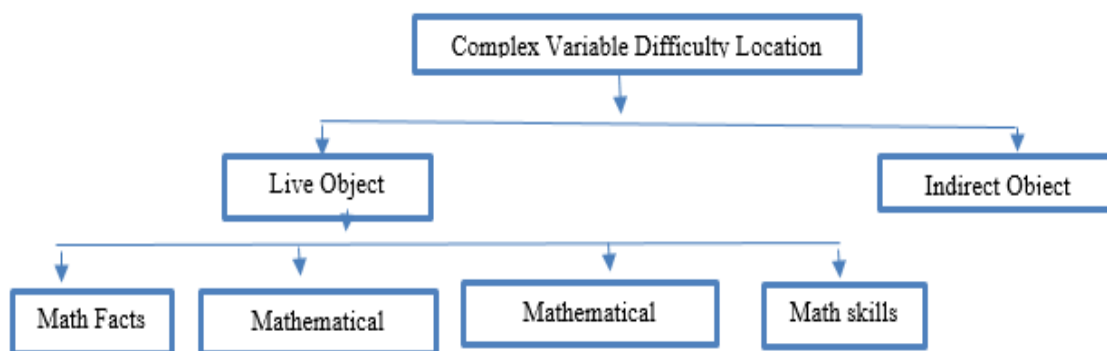


Figure 1. Difficulty Indicator

2.5. Media Selection and How to use

Media comes from the Latin word which is the plural form of medius which means introduction.Ridha Yoni Astika, Bambang Sri Anggoro, and Siska Andriani (2020) said introductory media or bridges in conveying messages from a material to be conveyed, the process of transformation, transfer of knowledge from one to another through assistive devices. Muthy and Pujiastuti (2020)Saying something that can be delivered by the media is a human message, material, or event that builds conditions that make students able to develop or acquire something new, skill, or attitude.Maryam, Masykur, and Andriani (2019)said that the media is something that cannot be separated from the learning process of teachers/lecturers with students/students. A person's learning outcomes are obtained from direct

experience, facts that exist in the environment around life, then develops into more abstract media. The benefits of the media are (a) the learning process is more interesting and motivated, (b) the material presented is more interesting and varied (c) the learning process method is more; (d) students are more active in discussions (Damayanti and Qohar 2019). Muthy and Pujiastuti (2020) argues in choosing the media a) has the aim of demonstrating teaching materials in an interesting way, b) has mastered the media, c) the media can provide a more concrete picture, d) the media can attract the interest of students. Febrian, Astuti, and Antika (2019) Every student who wants to solve a problem, must go through the process of making a decision, seeking information and trying to understand deeply the intent and purpose of the problem. In the process of seeking this information, the thought process develops and of course many questions arise. Ridha Yoni Astika, Bambang Sri Anggoro, and Siska Andriani (2020) said that the campus is a place to teach students to think all mental activities in an effort to solve problems, make decisions, interpret things, search for answers in getting a meaning. Conceptual Thinking Process. Conceptual thinking process is a thinking process that always solves a problem using the concepts that he already has based on the results of his assessment so far. The characteristics are: Understanding the problem, compiling a settlement plan, implementing a settlement plan. Semi-conceptual thinking process. The semi-conceptual thinking process is a thinking process that tends to solve a problem by using the concept that is not yet fully complete, so the solution uses intuition. The characteristics are: Understanding the problem, compiling a settlement plan, implementing a settlement plan. Computational thought processes. Computational thinking process is a thinking process that generally solves a problem not using concepts but relying more on intuition, as a result students often make mistakes in solving problems. The characteristics are: Understanding the problem, students do not understand the problem, develop a plan of completion, carry out the plan of completion

3. Methods


This type of research approach is descriptive qualitative research. (Zaluchu 2020). Research wants to describe how the actual incident. The researcher wants to record the whole series of learning processes and describe the results of the observations in the form of sentences with the concept of mathematical thinking, then continue with interviews and documentation. Time and Location October 2021 - January 10, 2022. The research was conducted in the Complex Variable Analysis course, Semester VII of the Mathematics Education Study Program. The research subjects were 12 people with an average age of 20 years. The data collection technique used is by obtaining primary data (Zaluchu 2020) namely Observation. Researchers compiled observation sheets by referring to the indicators of the difficulty of the direct object (Facts, Concepts, Skills and Principles) and indirect objects. The observation sheet is used as the basis for seeing the location of students' difficulties in complex variables. The researcher observed the students based on the observation sheet and checked the qualification section. Then proceed with the processing of interview data and documentation. The results of interviews and documentation are the opinions of research subjects and solid evidence in overcoming problems or difficulties faced by students. Analysis of observations, interviews and overlapping documentation is presented, reduced and then draw conclusions.

4. Results and Discussions

4.1. Results

The table 1 is the result of the analysis of the researcher's security, where the data is presented, reduced and then interpreted into sentences. It can be seen in the coding table, that students have more dominant difficulties in direct objects. Difficulty understanding facts, difficulty with concepts, inadequate skills and principles that are not strong in producing accurate answers.

Table.1. Coding of research observation results

| Code | Difficulty Keyword | Interpretation of Observation Results |
|-------------------------------------------------------------------------------------------------|--------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|  Live object | Fact | Many do not understand the definition, do not understand the relevance of the material, do not understand the meaning of symbols, errors in arithmetic operations, cannot provide relevant examples. |
| | Draft | Difficulty determining results correctly, weakness in completion, wrong results and difficulty showing friends the truth. |
| | Skills | Difficulty defining symbols in each material, difficulty choosing a formula, difficulty describing the beginning and end of the problem. |
| | Principle | Result error and difficulty finding the solution method |

| | | |
|--|-----------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| | Indirect Object | Students do not have other sources of application in obtaining other sources, students do not look for other sources of problems, help other students by providing answers, have difficulty using media in writing mathematics. |
|--|-----------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

Table 2. Coding of interview results

| Code | Keywords | Number of interviewees 7 people | In Percent | Interpretation of interview results |
|------|-----------------|------------------------------------|------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| | Fact | 5 | 71.42% | Difficulty in understanding the definition of complex variables, difficulty in relating one material to another |
| | Draft | 5 | 71.42% | Difficulty solving problems, difficulty giving examples and difficulty connecting material relationships |
| | Skills | 3 | 42.85% | It is difficult to operate the media used, and difficult to provide relevant examples. |
| | Principle | 4 | 57.14% | Difficulty proving the formula and its use, difficulty solving problems and explaining to group friends |
| | Indirect object | 2 | 28.57% | Difficulty in mathematical communication methods, difficulties in using media in writing mathematical operations, and difficulties in sharing mathematical concepts in the form of percentages |

The results of student interviews argued that the facts and concepts of complex variables were more difficult. This difficulty creates new difficulties in understanding the principle, as a result students' skills are not conceptualized.

Table 3. Coding documentation/verification

| No | Indicator | Interpretation Evidence/Documentation |
|----|-----------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1 | Live Object | Documentation shows difficulties in understanding the definition of complex variables, understanding the relevance of the material, solving complex variable questions and providing examples of questions related to the material. |
| 2 | Indirect Object | Difficulty using media in explaining material/percentage |

From table 3, the evidence of documentation can be seen that the results of observations and interviews coincide with documentation. Students do not master the definition, have difficulty connecting one material to another. Difficulty in explaining examples of questions and questions to classmates and students' difficulties when writing in the media used.

4.2. Discussions

1) Mastery of complex variables.

From the coding presented above, it is clear that the data obtained from observations, interviews and documentation intersect with each other regarding student difficulties in mastering complex variable subjects. This is experienced by students, starting from understanding definitions, connecting one material to another, understanding abstract concept examples, solving problems and explaining questions to less classmates. The discussion method made by educators is not effective because the online learning process is not suitable for complex variable courses, the limitations and difficulties of students in operating the media, the internet used is not good, writing mathematical symbols is not mastered. In the interview session, the source argued, there were 71, 42% are unprepared in understanding and mastering facts (definitions), because this course is too abstract in terms of definitions to be understood. Students argue that they need additional time to re-learn courses related to complex variable courses, such as courses in differential equations and calculus, Structure Algebra, Linear Algebra and real analysis. The low mastery of students in complex variable subjects indicates that there are problems of understanding and lack of mastery in the previous courses. Mastery of real and imaginary numbers. Students have difficulty determining definitions and concepts of imaginary numbers. The theory says that a lack of understanding creates new difficulties. The following is an example of a student not mastering the facts and concepts of imaginary numbers.

In the figure 2, the teacher has to repeat the facts and concepts of imaginary numbers. Meanwhile, this material already exists in calculus courses and other courses which are prerequisites for taking complex variables courses. This becomes a new problem and for mastery of the next material. Educators also need a lot of time to re-explain the material on imaginary numbers. This problem makes the lesson plans that have been designed not run as expected.

$i^2 = -1$
 $i^5 = (i^2)^2 \cdot i = (-1)^2 \cdot i = 1 \cdot i = i$
 $i^{101} = (i^2)^{50} \cdot i = (-1)^{50} \cdot i = 1 \cdot i = i$

Figure 2. Difficulty of Facts and Concepts of Imaginary Numbers

a. Menentukan (i^n) n = Bilangan Bulat

$$i^0 = 1$$

$$i^1 = i$$

$$i^2 = -1$$

Perlu di ingat bahwa 1^2 Tidak seperti ini

$$i^0 = 1 \rightarrow i = \sqrt{-1}$$

$$i^1 = i \rightarrow i \times i = \sqrt{-1} \times \sqrt{-1}$$

Figure 3. Lack of mastery of concepts and principles of complex variable material

The concept of the figure 3 is the difficulty of explaining the principle of complex numbers. The difficulty of mastering facts is 71.42%, resulting in 71.42% of concept difficulties and 57.14% of principles in solving questions to be incorrect. In this material it takes a lot of time to re-explain the basic concepts of complex numbers and other materials.

SOAL 8
A
 Pada Soal 8.1 –8.10 tentukan daerah analitisitas untuk fungsi yang diberikan. Buktikan jawabanmu.
 8.1. $x + iy$ 8.2. y^2
 8.3. z^2 8.4. $z^2 - 1$
 8.5. $\frac{z-i}{z+1}$ 8.6. $\frac{z^2+z}{z(z^2+1)}$
 8.7. $\ln|z| + i \text{Arg } z$ 8.8. $\sin x \cosh y + i \cos x \sinh y$
 8.9. $e^{z^2-2}(\cos 2xy + i \sin 2xy)$ 8.10. $h(z)$
 Pada Soal 8.11.–8.16. tunjukkan bahwa komponen nyata dan khayal setiap fungsi berikut adalah fungsi harmonik.
 8.11. $z^2 + z$ 8.12. z^3
 8.13. $1/z$ 8.14. $e^{i(\cos y + i \sin y)}$
 8.15. $\sin x \cosh y + i \cos x \sinh y$ 8.16. $e^{z^2-2}(\cos 2xy + i \sin 2xy)$
 Pada Soal 8.17.–8.20. tunjukkan bahwa fungsi yang diberikan harmonik. Kemudian dapatkan harmonik sekawannya v untuk membentuk fungsi analitik $f = u + iv$
 8.17. $u = x$ 8.18. $u = xy$
 8.19. $u = \ln(x^2 + y^2)$ 8.20. $u = e^{z^2} \cos y$
B
 8.21. Tunjukkan bahwa jika f' ada pada suatu titik, maka itu diberikan oleh
 $f' = u_x - iv_y = v_y + iv_x$

Figure 4. Mastery of the first student in solving problems

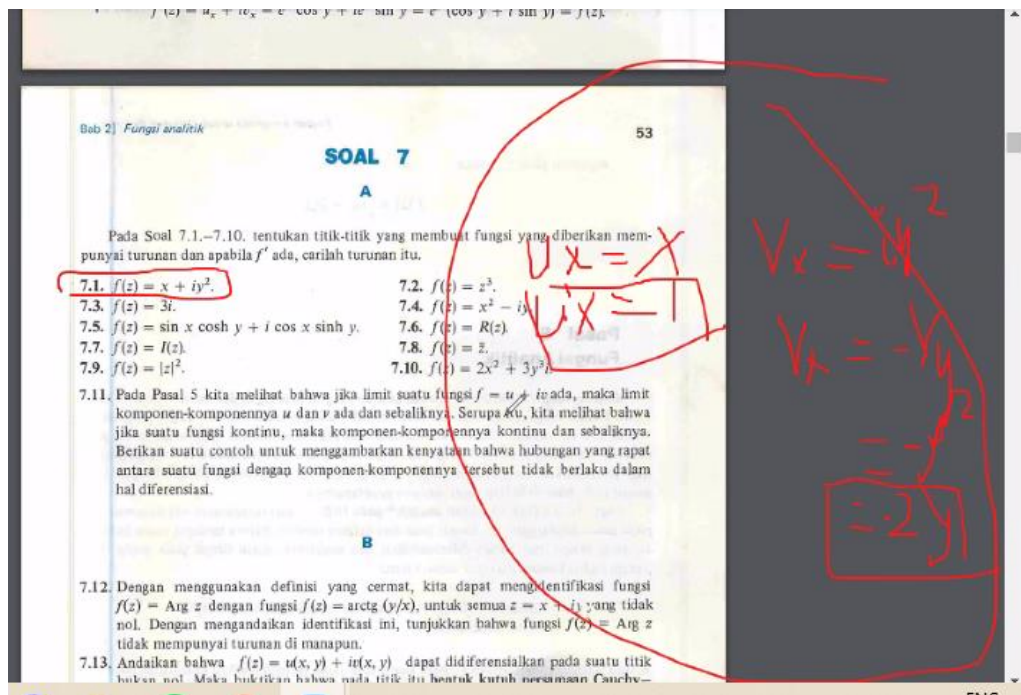


Figure 5. Mastery of the second student in solving problems

From Figures 4 and 5, it is clear that students in mastery are very weak when working on questions. Educators make discussion methods to discuss questions, but the expected results remain the same and are not understood. In fact, this material is in the calculus course, which previously and students have been said to have passed. In overcoming the problem of lack of mastery of facts and concepts, educators compile material related to definitions that are not understood, compose 3 examples, then give them to students who do not understand. It must be admitted that the learning process for complex variable courses is a little disturbed, because they have to repeat the material that has been learned in the previous course. The second step is to overcome weaknesses in mastery at the next meeting.

2) Difficulty understanding complex variables.

The difficulties experienced by students can be seen from the data obtained from observations, interviews and documentation which intersect with each other. Observational data shows that students' difficulties lie in understanding the principles and solving problems. This happens, due to lack of mastery in terms of facts and concepts. Students cannot solve problems, even if they are simple questions. This difficulty continues in the following questions. The results of interviews with students also have the same opinion, difficulties starting from the inability of students to master the material, connecting one material to another, difficulties at the principle stage used in completing. In the interview session, there were 5 people, 71.42% had difficulty in facts, 5 people had difficulty with concepts, 4 people had difficulty in principle and 3 people had difficulty in skills. Five people who have difficulty in facts argue that they are not able to connect one material to another, basic concepts are needed in mastering mature in terms of definitions. Insufficient abilities and difficulties felt by students in the material, lead to a general lack of understanding in solving concept problems. The principles that are understood by students also show that students do not understand when presenting their group material. This is evident in the documentation, students have difficulty working on the problem, even though it is only question number 1. In the interview, the reinforcer of difficulties in using the formula or principle used was also conveyed by the students. Insufficient abilities and difficulties felt by students in the material, lead to a general lack of understanding in solving concept problems. The principles that are understood by students also show that students do not understand when presenting their group material. This is evident in the documentation, students have difficulty working on the problem, even though it is only question number 1. In the interview, the reinforcer of difficulties in using the formula or principle used was also conveyed by the students. Insufficient abilities and difficulties felt by students in the material, lead to a general lack of understanding in solving concept problems. The principles that are understood by students also show that students do not understand when presenting their group material. This is evident in the documentation, students have difficulty working on the problem, even though it is only question number 1. In the interview, the reinforcer of difficulties in using the formula or principle used was also conveyed by the students.

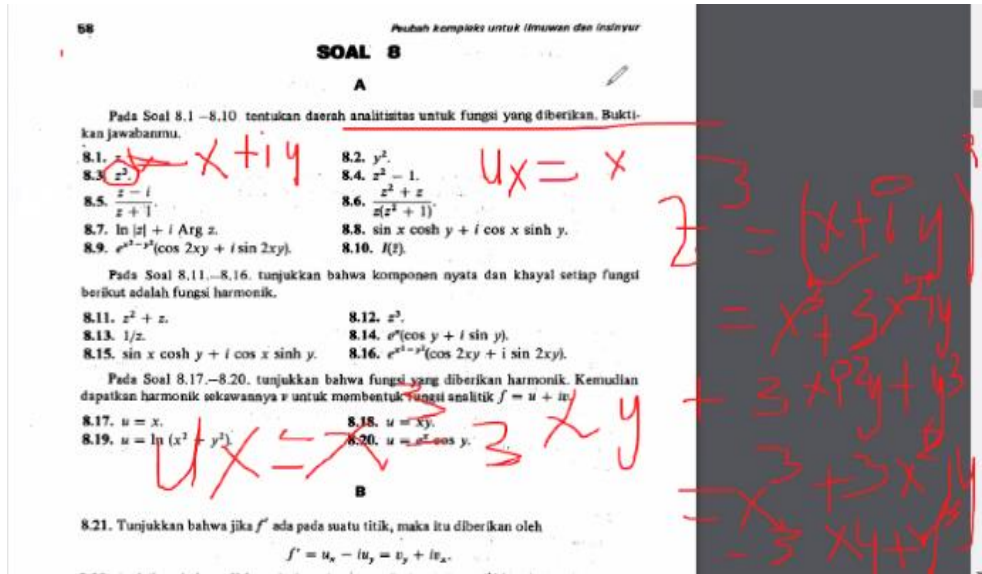


Figure 6. Difficulty of Principles and Skills

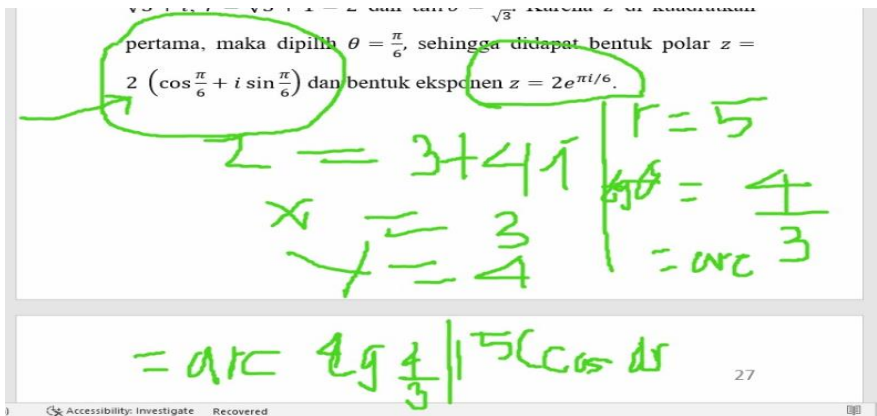


Figure 7. Concept Difficulty

The results of observations and interviews are proven to coincide and are supported by the above documentation. Lack of understanding of concepts, principles and lack of skills resulted in not achieving the expected learning outcomes. This is in line with the theory, difficulty in objectivity directly affects learning outcomes.

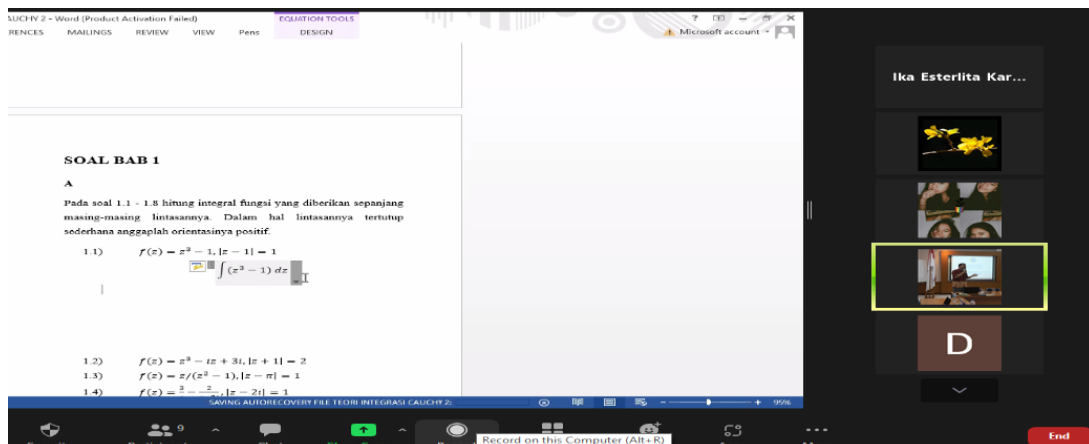


Figure 8. Difficulty in using media

Apart from direct object difficulties, difficulties are also seen when educators help direct students to write symbols and problem solving concepts. Students have difficulty writing symbols mentioned by the teacher. Even though the symbols mentioned were quite a lot in the previous courses. Such as writing integral to dx, integral to dy and arithmetic operations. In overcoming this problem, the researcher explains the questions that are considered difficult, then the researcher writes by typing 5 questions that are the same as those that have been explained by the researcher, then giving them to the groups that have been formed. The group is done together and presented. This method helps students a little in overcoming difficulties, but requires a lot of time and readiness from the educator.

3) Indirect object control.

In the direct object, students master the media used to conduct discussions. However, students have difficulty explaining and presenting and writing down the concept of solving problems asked by other students. This discussion process takes quite a lot of time. For one question up to five questions, it takes 1 hour, this is caused by students writing using Equation.

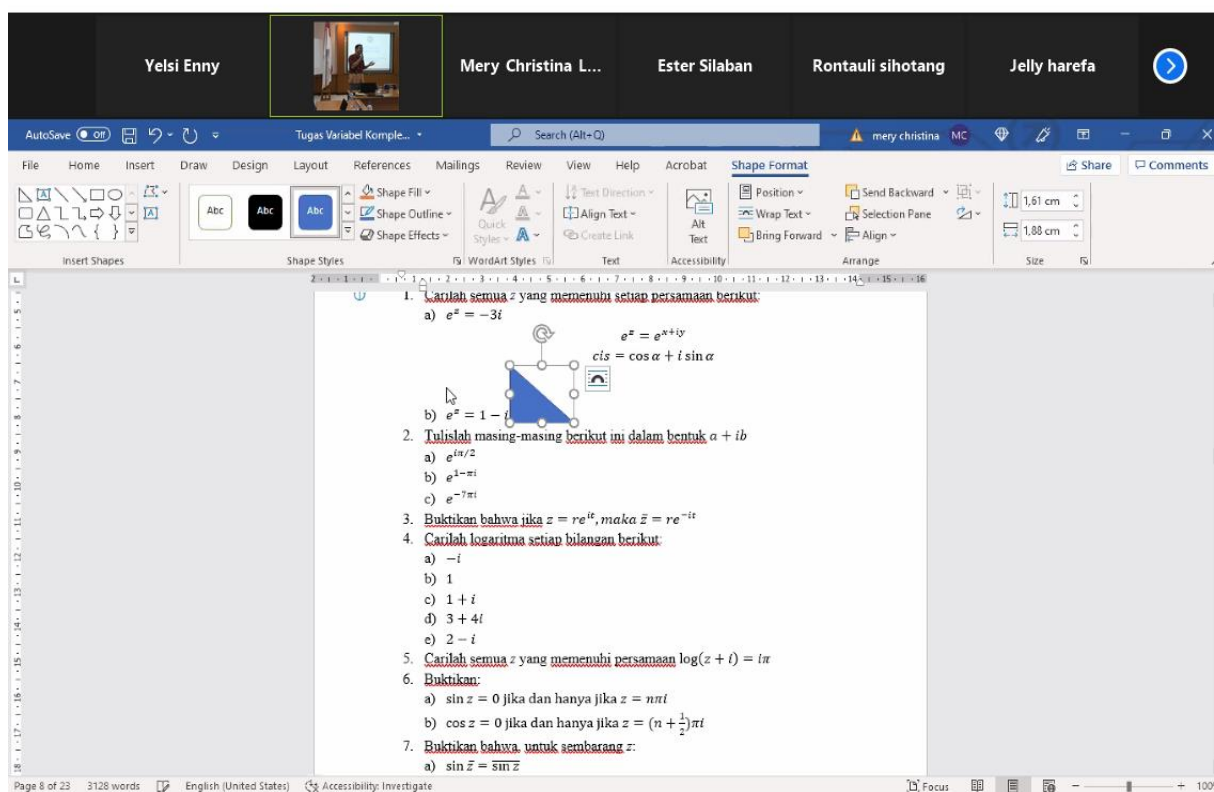


Figure 9. Difficulty when drawing

Security and interview results are interrelated and confirmed documentary evidence overlaps with the difficulty of using media as a percentage. Difficulties and lack of mastery in writing symbols lead to different understandings between students who are percentages and students who listen, at this point the educator tries to straighten out the writing method that students use when percentages. It also takes a lot of time to train students how to write symbols, arithmetic operations and find sources related to the questions to be discussed. In solving this problem, the researcher gave assignments to students to write in mathematical form the material that had been presented. This method helps and trains students in mastering writing mathematical symbols.

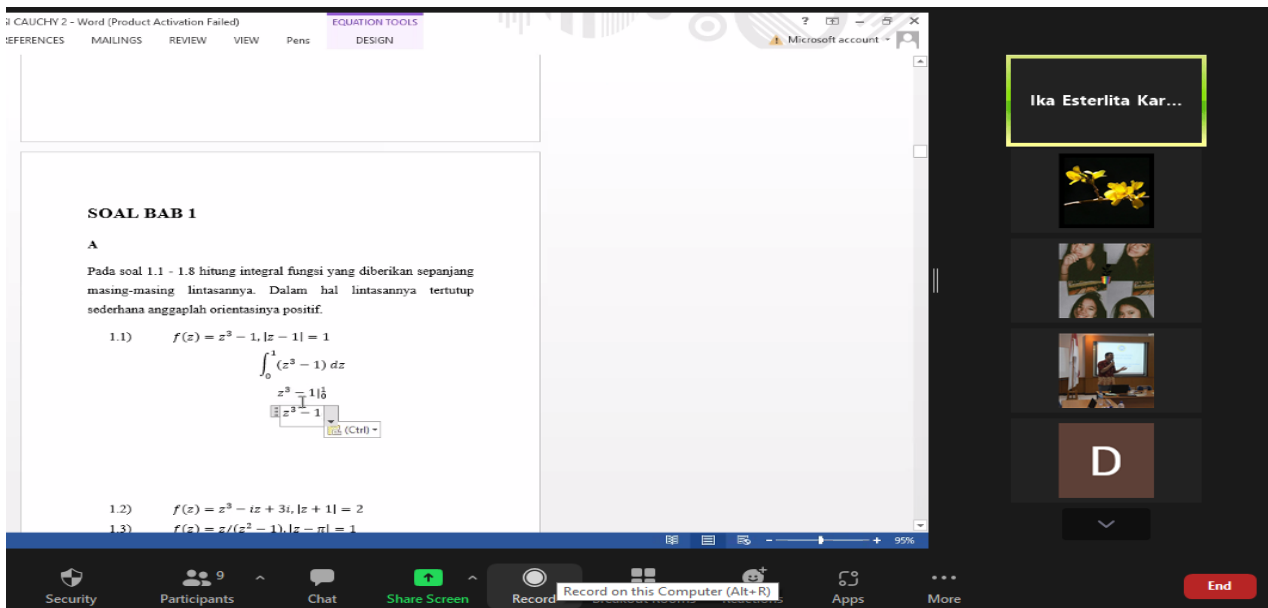


Figure 10. Lack of media control at the time of percentage

5. Conclusion

From the results and discussions, the conclusions are: The student's difficulty lies in the facts with the results of the opinion of the student being 71.42% and the concept 71.42%. These two indicators, which are in the direct object, are the main causes that are difficult for students to master. Lack of mastery, resulting in difficulties in principles and skills. The facts and concepts in the complex variable course are very abstract. Another factor is that students' mastery in previous courses is very low, even though students have graduated. Student success in previous courses was driven by indirect object factors and not direct objects. This can be proven from the results of this study, where students admit that they did not understand the previous material. Difficulty is also seen that students are not able to relate one material to another. Indirect objects that have helped students a lot so far, in this study, new difficulties were found. In online implementation, students have difficulty with percentages, write symbols in complex variables and have difficulty operating the media used. This is a new problem for mathematics students in achieving good learning outcomes with the assessment standards made previously objectively. write symbols in complex variables and difficulties in operating the media used. This is a new problem for mathematics students in achieving good learning outcomes with the assessment standards made previously objectively. write symbols in complex variables and difficulties in operating the media used. This is a new problem for mathematics students in achieving good learning outcomes with the assessment standards made previously objectively.

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