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Evaluation of Students' Difficulties in Learning Mathematics in Complex Variable Material

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ABSTRAK

Calon guru matematika dituntut untuk mampu menguasai fakta dan mampu memberikan contoh yang ada dalam kehidupan sehari-hari. Seorang calon guru matematika diharapkan terampil dan matang dalam menggunakan media saat mengoperasikan, menjelaskan dan mendemonstrasikan objek langsung yang ada pada setiap materi variabel kompleks. Tujuan penelitian ini adalah untuk menganalisis hambatan dan kesulitan mahasiswa dalam Matematika. Dua indikator penilaian hasil belajar matematika: 1) Objek langsung (Fakta, Konsep, Keterampilan, dan Prinsip), dan 2) Objek tidak langsung (Internet dan teman). Metode penelitian mixed methods. Subjek matakuliah matematika variabel kompleks dan objeknya mahasiswa. Teknik pengumpulan data kualitatif dengan observasi, wawancara, dokumentasi dan teknik pengumpulan kuantitatif metode survei dengan membagikan instrumen. Analisis dengan, penyajian, reduksi, menyajikan diagram batang, sinkronisasi data dan penarikan kesimpulan. Temuan, kesulitan mahasiswa terletak pada objek langsung yaitu penguasaan Fakta matematika 95.55% dan kesulitan konsep 91.11%, kesulitan prinsip (rumus) 91.11% dan algoritma sebesar 75.55%. Para mahasiswa yang mendapat nilai bagus saat online dibantu oleh objek tidak langsung yaitu internet dan teman diskusi mahasiswa lain. Kesimpulan, hambatan dan kesulitan mahasiswa terletak pada objek langsung indikator fakta (definisi) dan konsep. Desain materi, fakta dan konsep dengan model diskusi kelompok menjadi solusi pembelajaran.

ABSTRACT

Prospective mathematics teachers are required to be able to master facts and be able to give examples that exist in everyday life. A prospective mathematics teacher is expected to be skilled and mature in using media when operating, explaining and demonstrating direct objects that exist in any complex variable material. The aim of this study is to analyze the obstacles and difficulties of students in Mathematics. Two indicators for assessing mathematics learning outcomes: 1) Direct objects (Facts, Concepts, Skills, and Principles), and 2) Indirect objects (Internet and friends). Mixed methods research method. The subject of the complex variable mathematics course and the student object. Qualitative data collection techniques by observation, interviews, documentation and quantitative survey method collection techniques by distributing instruments. Analysis with, presentation, reduction, presenting bar charts, data synchronization and drawing conclusions. The findings, students' difficulties lie in the direct object, namely mastery of mathematical facts 95.55% and concept difficulties 91.11%, principle (formula) difficulties 91.11% and algorithms 75.55%. Students who get good grades online are assisted by indirect objects, namely the internet and other student discussion partners. In conclusion, students' obstacles and difficulties lie in the direct objects of fact indicators (definitions) and concepts. Material design, facts and concepts with group discussion models are learning solutions.

1. INTRODUCTION

Mathematics education in the world continues to grow, because mathematics is the basis of all knowledge in which there is logic, facts and language. In dealing with the development of mathematics education, tertiary institutions take a role in producing prospective mathematics teachers who can develop personality, character and professional competency skills and can operate technology (García-álvarez et al., 2022; González-pérez & Ramírez-montoya, 2022; Oschepkov et al., 2022) . It must be realized that mathematics lessons in tertiary institutions are an important science in training thinking processes to recognize facts (Basilotta-Gómez-Pablos et al., 2022; Hainora Hamzah et al., 2022) . However, in reality there are still many tertiary institutions that produce prospective mathematics teachers who place more emphasis on the transformation of values than on the transformation of knowledge, concepts and facts in the field of mathematics (Lauret & Bayram-Jacobs, 2021; Lin et al., 2021; Marginson, 2022).

The success and failure of prospective mathematics teacher students can be measured by the extent to which they understand the material, explain examples, provide answers and prove answers (Granberg et

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al., 2021; Richter et al., 2021). The success of learning mathematics can also be seen during the learning process which is measured by the level of understanding and mastery of the material through the questions given. In mathematics, there are two indicators that are generally used to measure the success of future mathematics teacher students (Tong et al., 2021; Powell et al., 2021). These indicators are direct objects and indirect objects (Schröter, 2020; Tong et al., 2021). One of the materials in mathematics that is difficult to achieve success through direct object indicators is complex variables and differential equations. Difficulties during the learning process are caused by internal factors that can hinder. The condition of students who experience obstacles from certain factors, will get further difficulties continuously (Lebrasseur et al., 2021; Lindholm, 2021; Martín et al., 2021).

In mathematics, there are two kinds of objects, namely direct objects and indirect objects. The direct object is 1) Facts, namely agreements made by experts through agreements that have been unanimously agreed upon, either in symbols or in the numbers "5" "five", "α" "alva", facts: "+" addition operation, sine a special function in trigonometry. 2+2 = 4, 5-4 = 1 are examples of agreed facts (Gunasegaram et al., 2021; Güneri & Deveci, 2023), 2) concepts are ideas that have imaginative value and have goals that can be shown as examples and not examples (Huu et al., 2021; Ioannidis, 2022; Hsieh et al., 2021). Like cubes, triangles, cubes, plane shapes, spaces, sets, and radii are concepts in mathematics. The learning process in understanding the material is not only in the classroom but outside the natural surroundings, so that able to see facts and mathematical reality through daily activities. In everyday life mathematics is able to make students get a variety of new information.

So students will see patterns, relationships between various knowledge inherent in mathematics. Daily activities are sufficient to foster an understanding of mathematical concepts. Such as the notion of a trapezoid, the notion of a cube, the notion of a tube, the notion of a triangle and so on, 3) the principle is the most complete and complex object and has axioms. Principles also include theorems and postulates (Anne et al., 2022; Palha et al., 2013), 4) Skill or skill is someone who has advantages and speed in giving correct and precise answers to what is expected of the question. For example certain integrals, trigonometric substitution integrals, and so on (Aningsih et al., 2022; Chai et al., 2016; Sauri et al., 2022). Indirect object, Media comes from Latin which is the plural form of mediums which means introduction. The media is a bridge in conveying messages from the material to be conveyed, the process of transformation, transferring knowledge from one to another through tools (Alberto et al., 2022; Şentop Dümen et al., 2022). Something that can be conveyed by the media are messages, materials, and events that build conditions for students to be able to develop something new, skills, or attitudes.

The media is something that cannot be separated from the student learning process. One's learning outcomes are obtained from direct experience, facts that exist in the environment around life, then develop into more abstract media. The benefits of media are (a) the learning process is more interesting and motivating, (b) the material presented is more interesting and varied (c) there are more learning process methods; (d) students are more active in discussions (Degner et al., 2022; Hastasari et al., 2022). In choosing media, a) aims to demonstrate interesting teaching materials, b) has mastered the media, c) the media provides a more concrete picture, d) the media can attract interest, every student who wants to solve a problem, must go through a decision-making process , seeking information and trying to understand the purpose (Brouwer et al., 2022; Shakmaeva, 2022)..

Mathematics is a compulsory subject that must be mastered by students who are prospective teachers of mathematics, the complex variable course discusses the set of real numbers and imaginary numbers. In understanding complex variable courses, there are courses that are prerequisites, namely basic mathematics, basic calculus, advanced calculus, linear algebra, algebraic structures, real analysis, set theory, discrete mathematics, transformations, probability theory and differential equations (Alam, 2020; Coen, 2017). In achieving good learning outcomes in complex variable courses, it is not enough to just master the previous subject. However, prospective mathematics teachers must have high concentration, good learning readiness, high reasoning, logical thinking and mastery of direct and indirect objects which must be good in complex variable courses.

In previous study said students had difficulty mastering direct objects such as facts, concepts, principles and algorithms (Wijaya et al., 2022). This difficulty has an impact on the achievement of learning outcomes and understanding of prospective mathematics teacher students. In a survey conducted by research in the complex variables subject, there was a percentage of student learning outcomes in the Mathematics Education Study Program for the 2015/2016 Academic Year, only 32.4% scored fairly well and the remaining 67.6% were in the poor category. Fact another in the Middle Semester Examinations (UTS) of the Mathematics Education Study Program, the Teaching and Education Faculties, still have not achieved the expected learning outcomes (Firdausy et al., 2019). Of the 100 people who were surveyed, there were 63 students who were below the minimum completeness. Whereas in 2021, the learning outcomes for the Mathematics midterm exam are around 13% of students who get good scores, but those

who get low marks are increasing, namely 87%. The facts above do not stand alone, the researcher also looked at the scores of students at one of the tertiary institutions, by obtaining data from lecturers who teach mathematics courses in 2021, out of 100% of students taking complex variable subjects, there were 50% of students getting low grades and 50 The other % are in the quite good, good and very good categories. The difficulties experienced by students when learning mathematics are direct objects. Direct object difficulties fall into the categories of facts, skills, concepts and principles (Davy Tsz Kit et al., 2022; Tsai, 2020). The theory says that someone who studies mathematics must be able to master direct objects and indirect objects. The direct object consists of facts, concepts, principles and algorithms, while the indirect object is the use of the media as a tool to obtain other sources of answers and other references and tools to find answers to questions (Budi et al., 2020; Torchinsky, 2018).

Prospective mathematics teachers are required to be able to master facts and be able to give examples that exist in everyday life. It must be admitted that students' learning difficulties in mathematics are very diverse, but these difficulties are generally caused by two internal factors, namely the direct object. Direct object indicators are facts, concepts and principles. Other factors are external factors, namely the media used, friends, the community and the surrounding environment (Hillmayr et al., 2020; Lahdenperä et al., 2022). Students' difficulties in learning mathematics can be measured during the learning process by analyzing, through mistakes when working on test questions, when writing, when proving theorems and when presenting answers to classmates. Students who experience difficulties due to learning barriers during the implementation of the Mathematics learning process, the use of online technology that is less able to have a negative impact on results. A prospective mathematics teacher is expected to be skilled and mature in using media when operating, explaining and demonstrating direct objects that exist in any complex variable material (Haleem et al., 2022; Stecuła & Wolniak, 2022). By looking at the learning outcomes of complex variable courses obtained by prospective mathematics teacher students, both from the results of previous research, from surveys obtained and learning outcomes which are decreasing every year and the number of mathematics students who are experiencing failure is increasing. So this research sees that there are urgent things to do, because research sees that there is a gap between theory, reality and expectations or low student scores.

The purposes of this study were to analyze the students' obstacles when implementing complex variable courses then to analyze the location of math difficulties when online, and to analyze how students got the results of learning mathematics before. The uniqueness and novelty of this study is the discovery of obstacles and difficulties in obtaining detailed learning outcomes. The novelty of this research found ways to overcome difficulties in complex variable courses and this became a reference source for all mathematics education study programs to prepare and improve patterns of teaching mathematics, especially complex variable courses for students.

2. METHODS

The method in this research is Mixed methods (Creamer, 2021; Froehlich et al., 2020; Heap & Waters, 2019). Qualitative data obtained during observation, interviews and documentation. Meanwhile, quantitative data was obtained by distributing instruments to prospective mathematics teacher students (Khaizaar & Hidayat, 2022; Maybury et al., 2022; Paidican & Arredondo, 2022). The data obtained is interpreted in the form of numbers and sentences by describing the findings and actual events. The research recorded the entire series of learning processes, checklist sheets that had been prepared to describe field findings in the form of sentences. The object of the research was the mathematics course on complex variable material, which is in the Mathematics Education Study Program. The research subjects were prospective mathematics teacher students (Anthony J. Onwuegbuzie, 2021; Haser et al., 2022). The population in this study were all mathematics education students at three universities in Jakarta. As a sample, 120 students were asked to fill out the instrument. Meanwhile, 20 students were interviewed and one class of 20 people was observed and the process of learning Mathematics was directly observed.

Data collection techniques are using direct observation, interviews, collecting all documentation and surveys. Researchers compiled observation sheets with reference to direct object indicators and indirect objects. The observation sheet is used as a basis for seeing where the obstacles and difficulties of students are during the learning process. Researchers observed students based on observation sheets and checked the qualifications section. The next stage in obtaining data through interviews, interviews were conducted by asking 20 students directly by conducting interviews with the online method. The research conducted structured interviews with interview sheets that had been prepared by the research. The next stage is to collect all documentary evidence, the documentation obtained during the learning process is collected and coded to find similarities from the data obtained to the location of students' obstacles and difficulties when working on math problems and the location of difficulties when understanding

percentages. The final stage was conducting a survey of 120 students by distributing instruments that had been compiled based on indicators of direct objects and indirect objects in mathematics by creating Google from and links. The instruments that have been compiled have been validated by experts and all the instruments that have been distributed are in the valid category.

Data analysis techniques with data presentation. The data presented is in the form of results from observations and observations, namely data on the location of student obstacles and difficulties when working on math problems and the percentage of complex variable math problems, data from interviews with students as a whole, documentation data and survey data on student obstacles and difficulties. Then all the data that has been presented is reduced. The data was reduced by the researchers one by one by giving a code to the data with the same obstacles and difficulties. Each data with the same code was collected and aligned with the data obtained, both from interview data and documentation data. The overlapping data is interpreted into sentences and numbers (Borch, 2022; Nozari et al., 2022; Waldschläger et al., 2022). The last stage in the analysis is to verify and draw conclusions. Researchers categorize difficulties and classify the location of student difficulties, both in facts, concepts, skills, principles and in indirect objects, namely media use, family and friend support. The researcher carries out the process of compiling data, sorting and processing it into written sentences and is supported by simple numbers and complete documentation from the beginning to the end of the study.

Direct object and indirect object indicators are the basis for knowing the obstacles and the location of mathematical difficulties in complex variable material. The mathematical indicators is show in Table 1.

Table 1. Mathematical Indicators

Indicator	Indicator Section	Interpretation of Measured Indicators
Direct Object	Fact	Definitions, symbols, postulates and theorems of variables
	Draft	Models, methods and strategies for working on questions
	Principle	Formula Skills and Mastery
	Algorithm	Understanding Examples of structured questions and Work on structured questions
Indirect Object	Media	The media used, skills in using the media to find sources of information, answers, fluency in communication and skills
	Family environment	Family assistance
	Friend	Classmate help

3. RESULT AND DISCUSSION

Results

From the data that has been collected and which has been reduced, this research performs coding of each data source obtained. The result of coding from observation and observation data, interviews and documentary evidence which is also coded for evidence that often appears is show in Table 2.

Table 2. Coding Observation Results of Students' Difficulties in Mathematics

Difficulty Indicator		Interpretation of Observation Results	In %
Direct object	Fact	Students do not master facts, have difficulty interpreting facts, students cannot connect interrelationships between materials, minimal ability to give examples that are relevant to the material being studied	96.63 %
	Draft	Difficulty in the purpose of the question, and difficulty in explaining the question and difficulty in determining the correct answer.	93.66 %
	Principle	Has no way of solving, cannot operate the media used when presenting percentages and has difficulty writing symbols of mathematical material in the media.	86.66 %
	Algorithm	The difficulty of proving the minimum formula for mastering the theorem	80%
Indirect object	Media, Family environment and Friend	Students search for answers from the internet, student answers cannot be accounted for by explaining patterns in percentages, get instant answers, many student answers are the same even though they are essay questions and open questions. Many tasks are with the same processes and work patterns.	54.33 %

Table 2 show the result of the initial conclusions from the analysis process from observations, reduced and interpreted into sentences. Students who experience difficulties are more dominant in direct objects. Difficulty understanding facts and giving examples of facts, difficulty solving concepts by tying old material with new material, difficulty determining the correct answer. Difficulties in using media skills, difficulties in writing mathematical symbols for Mathematics material in online media. Meanwhile, students' weaknesses in indirect objects are seeking answers to questions through online media. The answers obtained by students instantly cannot be accounted for when the percentage results, students have difficulty answering questions from friends and questions from lecturers. Coding of student interview results is show in Table 3.

Table 3. Coding of Student Interview Results

Keywords		In %	Interpretation of interview results
Direct Object	Fact	100%	Mastery of the definition of material in Mathematics is minimal, difficulty connecting one material to another, and difficulty giving examples of facts
	Draft	93.33%	Difficulty solving problems, difficulty giving different examples and unstructured thinking patterns
	Principle	93.33%	Difficulty proving the formula, difficulty explaining through the media and difficulty writing symbols in the media.
	Algorithm	80.00%	Difficulty using the right formula, difficulty proving the formula, difficulty solving the right problem with the material
Indirect Object	Media, Family environment and Friend	66.66%	Get answers from the internet, get help from friends, and work on independent questions together

Base on Table 3 show the results of interviews with all informants stated that mastery of facts is the most difficult thing in Mathematics courses. Difficulty in mastering definitions is the basis that causes difficulties in understanding concepts, principles, examples and practice questions. Coding of documentation evidence results from student difficulties is show in Table 4.

Table 4. Coding of Documentation Evidence Results from Student Difficulties

Keywords		In %	Interpretation of interview results
Direct Object	Fact	93.33%	Difficulty in understanding the definition of mathematical material
	Drafts	93.33%	Difficulty understanding the relationship between old and new material, difficulty solving problems
	Principle	93.33%	Difficulty writing symbols when presenting Math questions on Zoom and other media.
	Algorithm	66.66%	Difficulty using the right formula, difficulty giving examples of related problems
Indirect Object	Media, Family environment and Friend	53.33%	Difficulties in using the media in explaining the material when the percentage is to friends who ask, mistakes in writing formulas and unstructured work processes.

From Table 4, it can be seen that the results of observations and interviews coincide with the documentation. Students who do not master definitions have difficulty connecting one material to another. Difficulties in explaining examples of questions and questions to classmates and students' difficulties when writing in the media used. Instrument result of the location of obstacles and difficulties in Complex Variable Mathematics is show in Figure 1.

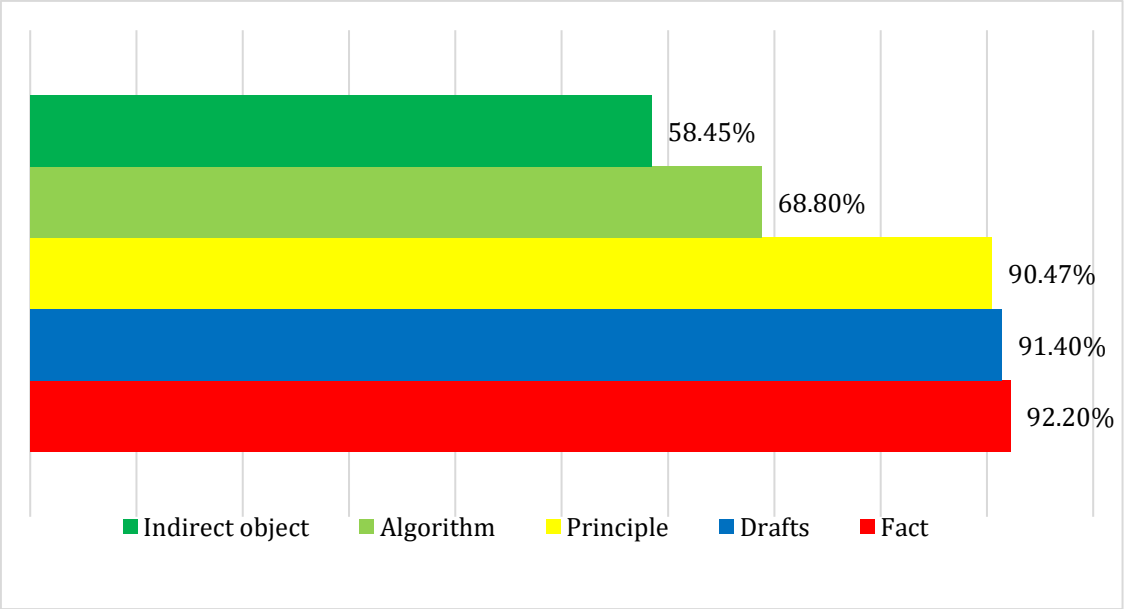

Figure 1. Instrument results for the location of obstacles and difficulties in Complex Variable Mathematics

Base on Figure 1 show that indirect object obtains lowest score related to 58.45%. Than followed by algorithm related to 68.80%. Principle found score around 90.47%. Drafts found score to 91.40%. And the highest one is Fact that found score 92.20%. Interpretation of data with observations, interviews, documentation and instrument results is show in Table 5.

Table 5. Interpretation of Data with Observations, Interviews, Documentation, and Instrument Results

Keywords		In %	Interpretation of Results
Direct object	Fact	95.55%	Lack of mastery of definitions (Facts)
	Drafts	91.11%	understand the relationship between old material and new material, can provide relevant examples, do not use methods, and prove formulas
	Principle	91.11%	Looking for answers from the internet, instant nature, helping friends in answering, helping with assignments, difficulties in mathematical communication methods, difficulties in using media in mathematical operations, and dividing concepts in percentages
	Algorithm	75.55%	understand applying the right formula as collateral, difficulty giving examples of related problems
Indirect object		58.10%	The use of media in explaining material when presenting percentages to friends who ask questions, errors in formulas and unstructured work processes.

Discussion

Student Obstacles When Studying

The findings in this study are in line with the findings of previous research that the difficulty lies in the direct object, namely the facts and concepts of mathematical material (Stovner & Klette, 2022; Supriyadi, 2022; Suseelan et al., 2022). From the results of the analysis it was found that the data obtained intersected between the result data obtained during observation, interviews, documentary evidence and instrument results on direct object difficulties. Obstacles were found in the lack of knowledge of students in the facts and concepts of Mathematics of Complex Variable Material. This obstacle creates difficulties for students to relate knowledge from old material to complex variable material. Difficulty giving concepts, difficulty explaining questions to friends when it comes to percentages. The discussion learning model carried out in the learning process becomes ineffective because students' mastery of facts is very minimal. Ineffective learning processes have an impact on understanding and student learning outcomes in mathematics with complex variable material (Yusop et al., 2022; Jääskä & Aaltonen, 2022; Lahdenperä et

al., 2022). It can be seen when explaining definitions and examples of facts, that it is not appropriate to do online learning for Mathematics courses on complex variable material. Students currently have difficulty explaining and writing math symbols online using the tools available on media zoom, google meet and the Teams application.

The results of interviews with students found that 100% did not know the facts (definitions). Complex variable courses contain many definitions and combinations of previous course material. Students feel the need for additional time to review previous course material before studying complex variable courses, such as differential equations, calculus, Structural Algebra, Linear Algebra and real analysis courses. This finding is in line with the opinion that the previous mathematics course had an impact on the mathematics course being worked on while studying (Booth et al., 2017; Csapó, 2022; Schukajlow et al., 2022; Watson et al., 2022). These study also found that high school mathematics mastery was low, students still had mastery problems and difficulties with real numbers and imaginary numbers, students had difficulty defining the definitions and concepts of real numbers and imaginary numbers. The theory says that the lack of understanding and mastery creates new difficulties (Pincheira & Alsina, 2021; Tong et al., 2021). The following is an example of a student who does not master the facts and concepts of imaginary numbers, where the lecturer has to explain how to understand and solve fairly simple problems. At the second meeting of the Mathematics course, the material provided was about the structure of numbers. It can be seen that students have difficulty understanding imaginary numbers. Imaginary number material has been studied in calculus and algebra courses, but in reality there are still many students who have not mastered the definitions, concepts and principles used in solving imaginary numbers as shown below.

In overcoming the problem of lack of mastery of facts and concepts, the first step for educators is to compile material that has not been mastered, definitions that have not been understood, compile 3 examples that are the same as the questions in the book. The material that has been designed is then given to students who do not understand. It must be admitted that the process of learning Mathematics in this way interferes with the lesson plans that have been designed previously, because they have to repeat and rearrange material that has been studied in previous courses. The second step is to overcome mastery weaknesses at the next meeting by the way the lecturer gives 5 questions to be completed by students and is allowed to open the previous subject book. Methods such as the first step and the second step have proven to be effective in helping students who do not master the direct object become able at the next meeting. This is in line with the opinion that state if the material is prepared according to student abilities and with the right methods it will have an impact on understanding the object directly when online (Chang & Lai, 2021; Hwang et al., 2021).

Mathematics Difficulties Online

The difficulties experienced by students can be seen from the data obtained during observations, interviews, documentation and assessment of intersecting instruments. Observational data shows that the most dominant student difficulties lie in direct objects (facts, concepts, principles and skills) in defining and solving problems. This happened because 96.63% and 93.66% did not know the facts and concepts during the observation. These two indicators cause problems in the principles and skills of students in solving problems, even though the questions are simple. This difficulty continues in the following questions. The results of interviews with students intersect with observations, difficulties ranging from inability to master definitions and connecting new material with old material as well as difficulties at the principle (formula) stage used. The combination of the four data obtained in table 5 shows, 95.55% fact difficulty, 91.11% concept difficulty, 75.55% principle difficulty, and 91.11% skill difficulty. Students who have difficulty understanding facts, are unable to connect material in previous courses with new material, need basic concepts in mastering material and questions. The difficulties felt by students lead to new mistakes in the next problem. Lack of knowledge skills in facts and definitions negatively impact when understanding the next material (Mayorova et al., 2021; Alban Conto et al., 2021; Khasawneh et al., 2021). The principles (formulas) that students understand are different from what they should be, this can be seen in the percentage of student group discussions. This difficulty was well documented, students wrote the wrong formula when working on the problem, even though the problem that each group worked on was only one question.

The results of observations, interviews and the results of student assessment of the instrument proved. The lack of mastery of facts and weak concepts resulted in difficulties in writing and understanding the correct principles (formulas) and students were unable to work on the questions correctly. This is in line with theory, low mastery and difficulty in concepts and understanding of the formulas of the material being studied affects learning outcomes (Marzuki et al., 2021; Sinha & Kapur, 2021). Difficulties were also seen when students wrote symbols, equations and the concept of answers to questions. In fact, the symbol expected by the problem is quite simple. Such as writing integrals, arithmetic operations, general equations

of complex numbers $x + iy$. In dealing with problems like this, the lecturer explains the material repeatedly, then continues with teaching writing symbols on the media, and the last stage the lecturer gives five questions that are the same as the examples of questions that have been explained. The questions given can be discussed together with other students by forming groups. Then the lecturer asked each group to work together and present the results of each group's answers to other groups through the media.

Strategies for Getting Mathematics Learning Outcomes

When students look for direct object sources on the material studied in complex variables, students find the source very easily. However, at the stage of writing answers in the media, students had difficulty writing symbols and compiling answers with lots of symbol errors. The way of presenting the concepts and principles in the material that has been discussed encounters obstacles. This has an impact on the mathematics learning process which is not effective if it only relies on online learning. To discuss even one issue and write about it in the media takes ten to Fifteen minutes. Observation data and cross-sector interviews show the location of student difficulties which are supported by documentary evidence which is reinforced by student responses through instruments showing that, when using the media as a tool to present and work on math problems it is not easy for students to do. The lack of mastery in writing symbols causes differences in understanding between students who have percentages and other students. This is in line with the theory, miswriting in mathematics will lead to multiple interpretations from other people (Signorelli et al., 2021; Moore et al., 2021). At this point, the lecturer tries to straighten out the writing method used by students when presenting percentages. Another solution that the lecturer provides is to give assignments at home to work on math problems on complex variable material by typing answers with mathematical operations in word. This method helps and trains students in the mastery of writing mathematical symbols.

In this study, the new thing that was found was the location of the obstacles and the location of students' difficulties so far in obtaining learning outcomes. Of the four indicators in the direct object, there are only two indicators that initially cause students to have difficulty getting good results. The solution of this research is that lecturers are expected to prepare material by prioritizing facts (definitions) and concepts properly and equipped with group discussion models. Research suggestions, in the future it is hoped that there will be further research using material development methods in the form of teaching materials or mathematics modules on complex variable material and contained in fact material (definitions) and concepts in a structured manner.

4. CONCLUSION

The conclusion of this study is that students' obstacles and difficulties in mathematics with complex variable material lie in the direct object, namely the low mastery of mathematical facts and concepts. Each has very high difficulty for students, it was found that for mastery of facts (Mastery of Definition) and mastery of concepts with each obstacle and difficulty found 95.55% and 91.11%. The two indicators in the direct object are the main causes for students experiencing obstacles and difficulties in understanding the material and getting good learning outcomes in complex variables courses. In this study it was also found that students used indirect objects, namely internet media to help them get good learning outcomes in Mathematics, especially complex variable material. The good marks that have been obtained by students in mathematics assignments are due to the support of indirect objects, namely the internet and the help of friends to solve problems. It can be proven by this research that indirect objects really help students to get the expected grades.

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