

ANALYSIS OF COMPLEX ANALYSIS PROBLEM SOLVING IN TERMS OF PROBLEM-SOLVING ABILITY

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ABSTRAK

Kemampuan pemecahan masalah merupakan kemampuan yang sangat penting dan harus dikuasai setiap individu dalam proses pembelajaran matematika. Relatif rendahnya kemampuan pemecahan masalah mahasiswa menyebabkan kesulitan dalam menyelesaikan soal dan kurang mampu mengembangkan ide serta kemampuan yang dimilikinya. Tujuan dari penelitian ini adalah menganalisis kemampuan pemecahan masalah dalam penyelesaian soal analisis kompleks khususnya dalam mengubah bentuk polar. Penelitian ini menggunakan pendekatan deskriptif kualitatif dengan subjek penelitian sebanyak 10 orang mahasiswa semester enam prodi Tadris Matematika UIN KH. Abdurrahman Wahid Pekalongan. Teknik pengumpulan data dalam penelitian ini adalah tes kemampuan pemecahan masalah berupa soal uraian analisis kompleks. Sedangkan teknik analisis data menggunakan analisis menurut *Miles and Huberman*, dimana aktifitas dalam analisis data ini antara lain: 1) reduksi data, 2) penyajian data, dan 3) penarikan kesimpulan. Berdasarkan analisis data, dapat disimpulkan bahwa hasil penelitian kemampuan pemecahan masalah bervariasi dalam kategori tinggi, sedang, dan rendah. Dari penelitian ini didapatkan bahwa kemampuan pemecahan masalah mahasiswa pada tahap memahami masalah, merencanakan strataegi dan melaksanakan strategi sudah dapat mengerjakannya, namun pada indikaor mengecek kembali jawaban sebagian mahasiswa tidak melakukannya. Penelitian ini memiliki potensi untuk meningkatkan ketrampilan abstrak mahasiswa dan dapat membantu meningkatkan kemampuan dalam memecahkan masalah matematika yang kompleks.

Kata kunci : Kemampuan pemecahan masalah, Analisis kompleks, Mahasiswa

ABSTRACT

Problem solving ability is a very important ability and must be mastered by every individual in the process of learning mathematics. The relatively low problem-solving ability of students causes difficulties in solving problems and is less able to develop their ideas and abilities. The purpose of this study is to analyze problem-solving skills in solving complex analysis problems, especially in changing polar forms. This research uses a qualitative descriptive approach with the subject of research as many as 10 sixth-semester students of the Tadris Mathematics study program UIN KH. Abdurahman Wahid Pekalongan. The data collection technique in this study is a problem-solving ability test in the form of complex analysis description questions. While data analysis techniques use analysis according to Miles and Huberman, where activities in this data analysis include: 1) data reduction, 2) data display, and 3) verification. Based on data analysis, it can be concluded that the results of problem-solving ability research vary in high, medium, and low categories. From this research, it was found that students' problem-solving skills at the stage of understanding problems, planning strategies and implementing strategies were able to do it, but in the indicator re-checking the answers some students did not do it. This research has the potential to improve students' abstract skills and can help improve their ability to solve complex mathematical problems.

Keyword: : Problem solving ability, Complex analysis, Students.

INTRODUCTION

In the context of mathematics education at the college level, understanding and application of complex number system concepts plays an important role in the development of mathematical analysis skills. The complex analysis course is the main place where students learn these concepts in depth.

The complex analysis course is a compulsory subject that students must take in semester 6. Students have already obtained and passed prerequisite courses such as calculus courses, introduction to basic mathematics and real analysis to become provisions before taking complex analysis courses (Sthephani, 2021).

Problem solving ability is a very important ability and must be mastered by every individual in the process of learning mathematics. according to Sumarno in (Anggraeni & Kadarisma, 2020) that the most important goal of learning mathematics is the solution of mathematical problems besides that it is at the heart of mathematics.

There are four processes that students carry out in problem solving according to Polya in (Rambe & Afri, 2020), i.e. (1) understanding the problem; (2) planning problem-solving strategies; (3) implement problem-solving strategies, and (4) re-examine the solutions obtained. So someone is said to have good problem-solving skills, namely someone who is able to understand the information contained in the problem as a whole and use the information to develop problem-solving strategies and solve the problem.

The relatively low problem-solving ability of students causes difficulties in solving problems and is less able to develop their ideas and abilities. Various factors cause and one of them is the stigma against mathematics, for example, mathematics is very difficult, difficult to understand, and very abstract (Ramda et al., 2020).

In previous research (Harahap, 2022) That students' mathematical problem solving skills on non-routine problems experience problems, this is because students have not been able to find problem solving strategies and have not been able to relate several materials in one problem.

In line with the results of observations made by researchers with sixth semester mathematics tadriss students of UIN KH. Abdurrahman Wahid Pekalongan that students sometimes make mistakes in doing problems related to their problem-solving abilities such as mistakes due to carelessness or lack of accuracy in reading questions, transforming information, errors in process skills, and misunderstanding of questions.

So based on the above problems, researchers are interested in knowing more about the mathematical problem solving ability of sixth-semester students of the mathematics education study program from this study is to analyze problem-solving abilities in solving complex analysis problems, especially in polar form material of complex numbers.

RESEARCH METHODS

This research uses qualitative research type research with descriptive methods. According to (Adiputra et al., 2021) Descriptive research is research that aims to describe existing phenomena, i.e. natural phenomena or man-made phenomena, or that is used to analyze or describe the results of a subject, but is not intended to provide broader implications. This research was conducted at UIN KH. Abdurrahman Wahid Pekalongan in the 6th semester students of the mathematics tadrís study program with the subject of 10 students.

The data collection technique in this study is a problem-solving ability test in the form of complex analysis description questions. While the data analysis technique uses data reduction, problem-solving ability using score guidelines based on problem-solving indicators. The instrument used in this study is a test of the ability of mathematical problems consisting of 2 points of description questions with polar form material of complex numbers.

After scoring according to the problem solving indicators according to Polya, then the scores obtained are converted in the range of 0-100 and determined the problem solving category as table 1. (Davita & Pujiastuti, 2020)

Table 1. Interpretation of problem-solving ability categories

Interval	Category
$80 \leq NA \leq 100$	High
$60 \leq NA < 80$	Medium
$0 \leq 60$	Low

The data analysis technique used in this study is the *Miles and Huberman* data analysis technique, where activities in this data analysis include: 1) data reduction, 2) data presentation (*data display*), and 3) conclusion drawing (*verification*).

RESULTS AND DISCUSSION

Complex numbers are expressed by $z = a + bi$, which is a quantity expressed in a , and b is a real number, the real part of z is a , denoted $Re(z)$, and the imaginary part of z is b , denoted $Im(z)$. Complex numbers can be expressed in polar form with $z = r(\cos \theta + i \sin \theta)$. The main value of z is $r = |z| = \sqrt{a^2 + b^2}$ and is written $\theta = \arctan \frac{b}{a}$ for $-\pi < \theta \leq \pi$. So, $-\pi \leq \arg z \leq \pi$ and $\arg z = \text{Arg } z + 2k\pi, k = 0, \pm 1, \pm 2$.

From the material of the polar form of complex numbers, researchers want to know the problem-solving ability of students. For this reason, students are given 2 points to do as follows:

1. The polar form of the complex number $z = +\sqrt{3} i$
2. Determine the polar shape of $z = 5 - 5 \sqrt{3}i$

The following are the results of student work based on the questions given:

1. High Category

$a = 1$
 $b = 2$
 $c = 1$
 $D = b^2 - 4ac$
 $= 2^2 - 4(1)(1)$
 $= 4 - 4$
 $= 0$
 $z = \frac{-b \pm \sqrt{D}}{2a}$
 $= \frac{-2 \pm \sqrt{0}}{2(1)}$
 $= \frac{-2 \pm 0}{2}$
 $= -1$

Figure 1. Results of solving S-3 question 1

$a = 1$
 $b = -2$
 $c = 1$
 $D = b^2 - 4ac$
 $= (-2)^2 - 4(1)(1)$
 $= 4 - 4$
 $= 0$
 $z = \frac{-b \pm \sqrt{D}}{2a}$
 $= \frac{-(-2) \pm \sqrt{0}}{2(1)}$
 $= \frac{2 \pm 0}{2}$
 $= 1$

Figure 2. Results of solving S-3 question 2

In the high category, S-3 can do the problem correctly. Judging from the working drawings of questions number 1 and number 2, S-3 is able to convey information known in the problem, determine the plan or strategy for solving problems, carry out the process of plans or solving strategies that have been determined appropriately, and re-examine the answers. In working on the problem, S-3 is able to solve the problem consistently according to the formula and understanding. Overall, the S-3 has implemented troubleshooting steps according to Polya. Of the ten respondents, S-3 had better criteria than others. So the S-3 can be categorized as high.

2. Medium Category

Dik
 1) Bentuk polar dari bil kompleks $z = \frac{\sqrt{3} + i}{2}$
 $r = \sqrt{(\sqrt{3})^2 + 1^2} = \sqrt{3+1} = \sqrt{4} = 2$
 $\theta = \arctan \frac{1}{\sqrt{3}}$
 $\theta = 30^\circ$
 Bentuk Polar $z = 2(\cos 30^\circ + i \sin 30^\circ)$

Figure 3. Results of solving S-1 question 1

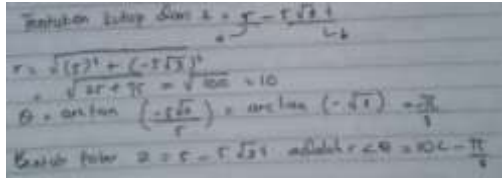


Figure 4. Results of solving S-1 question 2

In the medium category, in the figure above S-1 is quite capable of identifying the information contained in the problem. S-1 is able to devise problem-solving strategies with its own understanding. In question number 1 (Figure 3), S-1 performs problem solving by identifying known elements in the problem. In the second stage, that is, the problem-solving plan. S-1 is able to plan questions precisely according to his own understanding, but lacks in writing formulas. In the third aspect, namely implementing the completion plan, S-1 has been implemented according to the completion plan and the answer is correct. The S-1 has not been able to re-examine the answers that have been worked out. Furthermore, in question number 2 (Figure 4), S-1 was able to apply three problem-solving steps according to Polya, and in the fourth aspect, namely re-examining the answer, S-1 was not able to carry it out. S-1 can provide conclusions from answers despite errors in writing results. Overall S-1 is quite capable of applying the steps of solving mathematical problems. It's just that there are steps that are lacking in solving problems systematically and the re-examination stage in the discussion, then S-1 is included in the Medium category.

3. Low category

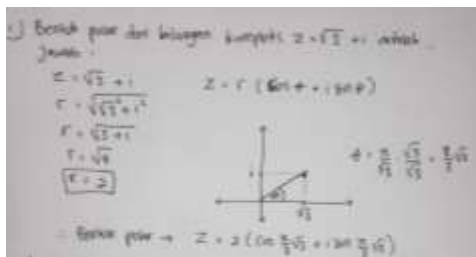


Figure 5. Results of solving S-5 question 1

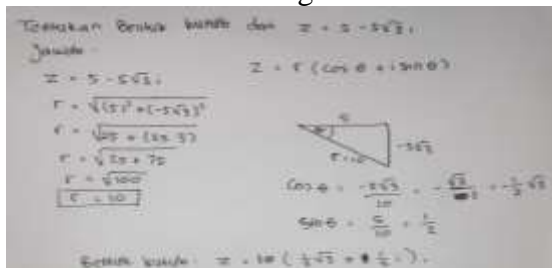


Figure 6. Results of solving S-5 question 2

In the low category, from figures 5 and 6 it can be seen that the S-5 is less able to solve the problems. In both problems, S-5 is less able to understand the problem and does not write down information from the problem. At the stage of choosing a completion plan, the S-5 has not been able to fully determine the strategy properly. The S-5 also did not carry out the corresponding plan. The application of the polar form formula used is incorrect. And did not do the fourth stage according to Polya, which is to re-examine the answers. So that the final result of the settlement is not quite right. From the discussion shows that the S-5 is in the low category.

The results of the analysis of solving complex number polar form problems in terms of problem solving ability according to George Polya. Students do not write down known information in the problem. Students also often make mistakes in problem solving planning due to lack of adequate understanding of the material. In carrying out planning in the formula completion section θ , students often make wrong calculations. Almost all students did not work on the fourth step of Polya, namely re-checking answers.

CONCLUSION

Based on the results and discussion, it can be concluded that problem-solving abilities vary in high, medium, and low categories. Students who belong to the high category very well perform all four problem-solving steps according to Polya. Medium category students are able to understand problems but are still lacking in implementing the solution plan and low category students are not enough to implement the four problem solving indicators. Students tend not to re-examine the results of the answers found. The results of this study can be used as a reference so that other researchers are moved to develop this research for other courses.

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