PROFILE OF STUDENTS' PROBLEM-SOLVING ABILITIES BASED ON KEIRSEY'S PERSONALITY IN SOLVING ETHNOMATHEMATICS PROBLEMS

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Abstract:
Problem-solving abilities are essential for students to face developments in the 21st century. This research examines students' problem-solving abilities in solving ethnomathematics-based problems in terms of Keirsey's personality type. This research uses a qualitative approach with a case study method. The research instrument is a questionnaire to measure Keirsey's personality type (artisan, guardian, idealist, and rational), an ethnomathematics-based problem-solving test instrument with the Polya problem-solving stages. Research subjects were chosen based on specific considerations: students with artisan, guardian, idealist, and rational personality types. Data collection was carried out using questionnaires, tests, and interviews. Based on the results of the analysis, it was found that each student with a different personality type had different problem-solving abilities. Students with a rational personality type can fulfill all stages of Polya problem-solving in each problem. Students with the guardian personality type skip checking back on a problem. Students with an artisan personality type lack planning. Meanwhile, students with an idealistic personality type cannot fulfill the problem-solving stages in all problems. These findings emphasize differences in problem-solving abilities for each personality type, so they can be used as a reference for designing learning based on personality type.

Keywords: Problem-Solving Ability, Polya’s Problem-Solving Stage, Keirsey’s Personality Type, Ethnomathematics.

PROFIL KEMAMPUAN PEMECAHAN MASALAH SISWA BERDASARKAN TIPE KEPRIBADIAN KEIRSEY DALAM MEMECAHKAN MASALAH ETNOMATEMATIKA

Abstrak:
Kemampuan pemecahan masalah penting untuk dimiliki oleh siswa untuk menghadapi perkembangan abad 21. Adapun tujuan dari penelitian ini adalah untuk

**Kata Kunci:** Kemampuan Pemecahan Masalah, Tahapan Pemecahan Masalah Polya, Tipe Kepribadian Keirsey, Etnomatematika


**INTRODUCTION**

Developments in the 21st century require everyone to have six skills known as 6C, which include critical thinking and problem-solving, communication, creativity and innovation, collaboration, computational logic, and compassion (Kemdikbudristek, 2020). Problem-solving ability is one of the skills that students need to have in the 21st century to keep up with the era of Society 5.0 (Sari, Anshori, Rohmah, & Dari, 2023). Also, problem-solving skills can help students think analytically to make decisions and improve critical thinking skills when dealing with specific situations (Dewi & Minarti, 2018).

Problem-solving refers to a cognitive process directed toward achieving a goal when initially a person does not know the method of solving the problem because problems arise when a person has a goal but does not know
how to achieve it (Mayer, 2019). Problem-solving abilities can help with problem-solving activities based on essential knowledge (Kurniawan, Setiawan, & Hidayat, 2019). Through problem-solving skills, students can increase their analytical power and apply it to various situations (Nurhasanah & Luritawaty, 2021). In learning mathematics, problem-solving skills provide benefits in seeing the relevance of mathematics to other subjects, even in real life (Latifah & Afriansyah, 2021). Several stages can be done to solve problems according to Polya (1978), namely 1) understanding the problem, 2) planning to solve the problem, 3) implementing a plan to solve the problem, and 4) looking back.

Facts in the field show that students' problem-solving abilities still need improvement. They still need help solving mathematical problems that require complex procedures and applications. (Gradini, Yustinaningrum, & Safitri, 2022; Novianti & Rosdiana, 2022). The 2018 Program International Student Assessment (PISA) study results show that Indonesia is ranked 73 out of 79 in the mathematics category, with a score of 379 from the OECD average of 487 with 379 with OECD average score of 487 (OECD, 2019). In 2022, Indonesia's PISA ranking in mathematics increased to 68 from 81, but the average decreased to 366 from the OECD average of 472 (OECD, 2023). Mathematics in PISA measures problem-solving and reasoning skills, so it can be said that PISA results show students' problem-solving abilities (Rosana, Widodo, Setianingsih, & Setyawarno, 2020). So, based on the PISA results, it can be seen that students' problem-solving abilities in Indonesia still need to improve (Asdarina & Ridha, 2020). That is also supported by daily learning results showing poor performance in mathematical problem-solving abilities (Hidayat & Sariningsih, 2018).

Problem-solving abilities must be identified, studied, and acted upon to design learning processes to improve them. One way to identify problem-solving abilities is by administering written and computer-based tests (Ridhwan, Sumarmi, Ruja, Utomo, & Sari, 2020; Scherer, Messinger-Koppelt, & Tiemann, 2014; Schoenfeld, 1982). Written tests are more accessible and can focus on problem-solving (Ridhwan, Sumarmi, Ruja, Utomo, & Sari, 2020; Scherer, Messinger-Koppelt, & Tiemann, 2014). Written tests that measure problem-solving must be story questions (Mawaddah, Anwar, Yusrizal, & Zubainur, 2021). When solving math story problems, students must understand the meaning of the problem and present it in mathematical form (Ratnamutia & Pujiausti, 2020; Restuningsih & Khabibah, 2021). However,
many students still have difficulty solving story problems, so it is necessary to develop questions closely related to students (Gunawan, 2018). One way is to develop questions based on culture or ethnomathematics because all forms and learning processes in mathematics will always be surrounded by a culture (Sroyer, Nainggolan, & Huta Barat, 2018).

Ethnomathematics is a way to study mathematics practiced in a culture (Saputra, Mirsa, Yanti, Wulandari, & Husna, 2022). Apart from being practiced in culture, ethnomathematics can be described as mathematics built from cultural knowledge (Kusuma, Suryadi, & Dahlan, 2019). Therefore, culture-based problems can encourage students to link their knowledge with culture and problems in real life (Ulya & Rahayu, 2020).

Apart from the form of questions that need to be considered, students' personalities must also be considered because they can influence their problem-solving abilities (Kaplan & Owings, 2017; Tarigan, Wulandari, Maulida, & Luluatnul, 2019; Zuniana & Rahaju, 2019). Personality consists of characteristic thoughts, feelings, and behavior patterns that make a person unique (Pundir & Agarwal, 2016). One personality classification that can be used is the Keirsey Personality Type. Kiersey divides personality based on temperament, character, and intelligence (Keirsey, 1998). Keirsey groups personalities into Guardians, Artisans, Rationales, and Idealists (Keirsey, 1998). In schools, guardian types tend to be interested in studying business; artisan types tend to be more interested in art; rational types prefer science; and idealist types are interested in humanities (Keirsey, 1998). In the learning process, the guardian type likes conventional learning models; the artisan type likes active classes with lots of demonstrations and discussions; the rational type likes logical learning; and the idealist type likes independent learning (Hidayatulloh, Usodo, & Riyadi, 2013). It can be seen that each type has a different way of learning and has a tendency to learn something, which means that each type has different characteristics that will influence their problem-solving abilities (Satya, Putri, & Nizar, 2022).

There are several previous studies regarding problem-solving abilities in terms of personality type. (Arini & Rosyidi, 2016; Mawaddah, Anwar, Yusrizal, & Zubainur, 2021; Rabbani, Baidowi, Wahidaturrahmi, & Sripatmi, 2022; Zuniana & Rahaju, 2019). However, there has yet to be any specific research regarding students' problem-solving abilities in solving ethnomathematics-based problems regarding their personality type. Therefore, this research focuses on students' problem-solving abilities in solving...
ethnomathematics-based problems regarding Keirsey's personality type. The results of this research can be used as a reference for developing learning based on ethnomathematics-based student personality types and problem-solving abilities.

METHODS

This research uses a qualitative approach with a case study method. This research begins with an introductory analysis and an analysis of the research needs. The data collection techniques used in this research consisted of tests and interviews. This research used two tests: the Keirsey personality type test and an ethnomathematics-based problem-solving ability test. A personality test aims to obtain information about the personality type possessed by students, and the results are used to determine research subjects and collect data that supports research. The problem-solving ability test is used to analyze student answers according to the stages of problem-solving ability. The type of interview that will be used in this research is a semi-structured interview because it is to find problems more openly.

The instruments used in this research were personality test instruments, problem-solving test instruments using ethnomathematics problems, and interview guides. The personality test instrument used is the Keirsey Personality Type Test, consisting of 16 questions about how a person responds to specific events according to their habits or thoughts (Keirsey, 1998). The Keirsey personality type test is used to classify personalities into guardian, artisan, rational, or idealist personality types. The ethnomathematics-based problem-solving test instrument consists of four questions arranged based on Polya's problem-solving stages, namely 1) understanding the problem, 2) planning to problem-solve, 3) implementing a plan to solve the problem, and 4) looking back or checking back on the results obtained (Polya, 1978).

Before the test instrument is given, the test instrument is validated using content validation. Meanwhile, the interview guide used in this research adapts to the stages of problem-solving abilities. This interview is used as accompanying data from the results of students' answers to the problem-solving ability test. The subjects in this research were 40 students in grade 12, who were then selected four people based on Keirsey's personality type, namely Guardians, Artisans, Rational, and Idealists. Previously, students filled out Keirsey's personality questionnaire, then classified based on Keirsey's personality type. Then, students are given ethnomathematics-based problem-
solving test questions on opportunity material. After the research subject was determined, the answers to the mathematical literacy ability test questions were analyzed using indicators of Polya's problem-solving ability. Next, the selected subjects are interviewed to confirm the student's answers. Finally, the data obtained is reduced and presented, and the results are concluded.

RESULTS AND DISCUSSION

This research obtained the results of the answers to the Keirsey personality questionnaire and the results of an ethnomathematics-based problem-solving test. Of the 40 students, there were 14 with artisan personalities, 6 idealist students, 13 guardian students, and 7 rationalist students. Next, four students were selected to represent each personality type. After a personality questionnaire, students are given an ethnomathematics-based problem-solving test of 4 essay questions on probability material.

Figure 1. Ethnomathematics-based Problem-Solving Test
After the subjects submit their answers, an interview is then carried out. The following are the results of the analysis of answers and interview answers to the four subjects based on the Polya problem-solving stages.

<table>
<thead>
<tr>
<th>Subject</th>
<th>Personality Type</th>
<th>Number of Question</th>
<th>Polya’s Problem-Solving Stages</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Understanding the Problem</td>
</tr>
<tr>
<td>SA</td>
<td>Artisan</td>
<td>1</td>
<td>o</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2</td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3</td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4</td>
<td>o</td>
</tr>
<tr>
<td>SI</td>
<td>Idealist</td>
<td>1</td>
<td>o</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2</td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3</td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4</td>
<td>✓</td>
</tr>
<tr>
<td>SG</td>
<td>Guardian</td>
<td>1</td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2</td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3</td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4</td>
<td>✓</td>
</tr>
<tr>
<td>SR</td>
<td>Rational</td>
<td>1</td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2</td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3</td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4</td>
<td>✓</td>
</tr>
</tbody>
</table>

✓ : Students can answer questions and fulfill indicators.
○ : Students meet the indicators but do not answer correctly.
✗ : Students do not meet the indicators.

Based on the results of the answers to the four subjects above, there are differences in the problem-solving achievements of students from each Keirsey personality type. The following is a discussion of each personality type.

1. **Artisan**

Based on Table 1, the students with artisan personality type, subject SA, can fulfill the problem-solving stages and complete the answer correctly on only one question out of four. In solving the problem, two questions did not plan to solve the problem first but solved it straight away. So, when solving
the problem, subjects with the artisan personality type could not answer the question correctly because they missed the problem-planning stage. That is in line with research results (Astuti, Aminudin, & Maharani, 2018) that show that students with artisan personalities can understand problems but have difficulty planning problem solutions, which results in students having difficulty solving problems.

![Figure 2. One of SG's answers](image)

As for another problem, the planning steps were implemented but needed to be done correctly. Meanwhile, rechecking the answer is only carried out on one resolved problem. Based on the interview results, it was also found that subject SA did not recheck his answer because he felt confident and had difficulty answering it, so he did not recheck it. Subject SA felt confident because the ethnomathematics problem given was related to the knowledge he had. In line with the research results (Masriyah & Firmansyah, 2018), students with artisan personalities solve problems without planning but according to what they believe. Artisan students can connect known information with the knowledge they have to make plans (Solichah & Sulaiman, 2019).

2. Idealist

The student with an idealistic personality, subject SI, can solve two problems correctly using problem-solving stages. One question fulfills the stages of understanding, planning, and implementing the plan but needs to be more precise. Meanwhile, the other one understands the problem correctly but cannot solve it. That is because the SI subject feels that the problem is too complex, so the SI subject feels confused in understanding and solving it. The SI subject can explain the problem but cannot explain how to solve it.
Subjects with an idealistic personality type have been unable to solve it correctly because they like to apply trial-and-error strategies (Masriyah & Firmansyah, 2018). Apart from that, it can also happen because idealistic types prefer to work together to solve problems. Even so, problems related to ethnomathematics help students with idealistic personalities with reading questions. The idealist type likes reading and writing, so they like math problems in the form of story problems (Nismaya, 2018).

3. Guardian

Based on the analysis results, SG (Guardian's Subject) could fulfill the problem-solving stages only on one question; SG did not check again. That means the student with the guardian personality type can understand problems, plan problem solutions, carry out orders, and even recheck the answers. Based on the interview results, it was also found that the SG subject felt that the problem given required deeper study to understand the problem. Subject SG felt that, at first, it seemed difficult, but after looking back, he could understand the problem. SG subject works slowly, not in a hurry, and double-
check to ensure the explanation is correct. The story about traditional games means SG didn't get bored reading it repeatedly. Problems with traditional games mean SG didn't get bored reading them repeatedly.

Figure 4. One of SG's answers

The analysis of students with the Guardian personality aligns with the research results (Masriyah & Firmansyah, 2018) that show that students with the Guardian personality type can model problems in mathematical form and design and implement strategies to solve problems. Apart from that, based on research results (Hanifa & Masriyah, 2019), students with the Guardian personality type start the problem-solving process by reading the problem to understand it, thinking of ideas to solve it, then solving it, and finally rechecking the explanation. Students with the guardian personality type are also interested in ethnomathematics problems, which aligns with research results (Kasriana & Ode, 2020) that show that the guardian type is interested in contextual problems.

4. Rational

Subject SR (student with a rational personality type) can solve all problems correctly using Polya's problem-solving stages. SR can understand the problem, translate it into his language, plan a solution, and implement it. The following research results (Hanifa & Masriyah, 2019) showed that students with a rational personality type can understand problems slowly, look for ideas for solving problems but do not have other alternative methods, and can solve problems well and recheck the answers to ensure.
Based on the results of the interview, the SR subject felt confident with the answer and was able to explain the solution process. That is in line with the research results (Masriyah & Firmanisah, 2018), which states that the solution results obtained by students with the rational type are correct and can explain the reasons based on the calculation process. The rationalist personality type is a type of person who thinks analytically so that the calculation process is explained as the reason for the correctness of the results. Students with a rational personality type can connect mathematics with everyday problems, such as those related to culture or ethnomathematics (Sutrisno, Nusantara, & Susiswo, 2019).

CONCLUSION

Based on the research results presented, each student with a different personality type has different problem-solving abilities. Students with a rational personality type have better problem-solving abilities than others because they can solve problems correctly using problem-solving stages. Students with the guardian personality type also have good problem-solving abilities, even though one problem still needs to be rechecked. Meanwhile, students with artisan and idealist personality types have problem-solving abilities that are not as good as rational or guardian personality types because problems cannot be appropriately solved using problem-solving stages. Even
so, ethnomathematics questions help every personality type in solving problems better. The results of these findings can be used as a reference for designing ethnomathematics learning based on personality type.

This research is limited to only analyzing the results of students' answers and confirming the answers without investigating the causes. Further research can identify the causal factors so that learning can be designed according to personality type for better problem-solving abilities.

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