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ERROR ANALYSIS OF PROSPECTIVE MATHEMATICS TEACHER IN SOLVING COMBINATORICS PROBLEMS BASED ON ADVERSITY QUOTIENT

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Abstract

The background of this research is that there are still many prospective teacher students who still experience difficulties in solving addition and multiplication rules in combinatorics. This research is a qualitative descriptive research that aims to find out the mistakes of prospective teacher students in solving addition and multiplication rules in combinatorics based on adversity quotient. The research subjects were 70 semester 3 prospective teacher students in Mathematics Education, Teaching and Education Faculty, Sriwijaya University. There are stages for this research including 1) preparation stage, 2) implementation stage, 3) final stage. Data collection was in the form of questionnaires, interview and written tests. The results of the study were that student teacher candidates who had a Quitter type adversity quotient had 0 student teacher candidates with a percentage of 0%, Camper type adversity quotient had 58 student teacher candidates with a percentage of 82.86%, Climber type adversity quotient had 12 student teacher candidates with a percentage of 17.14%. As well as prospective teacher students in the Adversity quotient category of the Climber type, they made 4 mistakes according to Newman's procedure, namely Comprehension Error, Transformation Error, Process Skill Error and Encoding Error. Student teacher candidates in the adversity quotient category of Camper type made 5 mistakes according to Newman's procedure, namely Reading Errors, Comprehension Errors, Transformation Errors, Process Skill Errors and Encoding Errors.

Kata kunci: Addition and multiplication rules; adversity quotient; combinatorics; error analysis.

Abstrak

Penelitian ini dilatarbelakangi oleh masih banyak mahasiswa calon guru yang masih mengalami kesulitan dalam menyelesaikan masalah aturan penjumlahan dan perkalian dalam kombinatorika. Penelitian ini merupakan penelitian deskriptif kualitatif yang bertujuan untuk mengetahui kesalahan mahasiswa calon guru dalam menyelesaikan masalah aturan penjumlahan dan perkalian dalam kombinatorika berdasarkan adversity quotient. Subjek penelitiannya mahasiswa calon guru semester 3 Pendidikan Matematika Fakultas Keguruan dan Ilmu Pendidikan Universitas Sriwijaya sebanyak 70 mahasiswa. Ada tahapan untuk penelitian ini diantaranya 1) tahap persiapan, 2) tahap pelaksanaan, 3) tahap akhir. Pengumpulan data berupa kuesioner, wawancara dan tes tertulis. Hasil penelitian yaitu mahasiswa calon guru yang memiliki adversity quotient tipe Quitter terdapat 0 mahasiswa calon guru dengan persentase 0%, adversity quotient tipe Camper terdapat 58 mahasiswa calon guru dengan persentase 82,86%, adversity quotient tipe Climber terdapat 12 mahasiswa calon guru dengan persentase 17,14%. Serta mahasiswa calon guru kategori adversity quotient tipe Climber melakukan 4 kesalahan menurut prosedur Newman, yaitu Comprehension Error, Transformation Error, Process Skill Error dan Encoding Error. Mahasiswa calon guru kategori adversity quotient tipe Camper melakukan 5 kesalahan menurut prosedur Newman, yaitu Reading Error, Comprehension Error, Transformation Error, Process Skill Error dan Encoding Error.

Kata kunci: Adversity quotient; analisis kesalahan; aturan penjumlahan dan perkalian; kombinatorika



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INTRODUCTION

Combinatorics is a branch of mathematics that is widely applied in everyday life (Simamora & Zunaiedy, 2021). To be able to apply it in life, a good understanding is needed in learning mathematics, especially in combinatorics material. (Syahputra, 2015) One of the reasons why combinatorics is important to be taught in schools is the many possibilities that occur in life in order to consider which steps to solve the problem. Ammamiarihta (2019) also said the reasons why combinatorics play an important role and must be taught and discussed in depth are (1) combinatorics does not require calculus requirements, so this material can be taught earlier, (2) combinatorics also helps students in making predictions, generalizing and thinking systematically, (3) combinatorics also plays an important role in arithmetic.

Based on research by Rahayuningsih & Octavianti (2016) said that in solving combinatoric problems students still experience errors consisting of conceptual errors, procedural errors and modeling errors in mathematical form. In addition, according to Astuti et al. (2017) revealed that student errors in solving math problems were a) errors in receiving information to restate a concept; b) errors related to the concept of classifying objects according to certain characteristics (according to the concept) and developing necessary or sufficient conditions for a concept, namely being able to examine which conditions are necessary and which are sufficient conditions related to an object; c) errors related to calculations (operations) and procedures; and d) errors in applying concepts or problem-solving algorithms. In addition, based

on Masroni & Nusantara (2018) regarding the analysis of student errors in using the multiplication rule and addition rule, namely First, the error experienced was an error in interpreting the material with the questions given. Students interpret the problem of addition rules as multiplication rules (thinking interference). The second error is the loss of students' understanding of the multiplication rules and addition rules.

To improve and improve in solving the problem, then we need to know the error. To find errors in solving a problem, then there is an error analysis. From that, the error analysis also aims to find out the real causes and conditions of the problem (Layn & Kahar, 2017). To find out the types of errors made in solving problems, researchers use Newman's error indicators.

Newman's error analysis according to Suyitno & Suyitno (2015) is divided into five namely reading problems, understanding problems, transforming problems, processing skills and writing answers. These five stages can be used to find out how, why and where students make mistakes in solving math problems. This error analysis is important to do in order to find out the location of student errors in working on questions (Cahyani & Sutriyono, 2018).

One of the factors that causes students to make mistakes in solving math problems is the ability to fight students (Hutami et al., 2020). Each student's ability to solve math problems is different. The difference in fighting ability is determined by the student's AQ. according to Stoltz (2000) adversity quotient is a person's ability to observe difficulties and process these difficulties with the intelligence they

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have so that it becomes a challenge to solve). Stoltz categorizes the adversity quotient into 3 categories, namely high adversity quotient (climber), moderate adversity quotient (camper), and low adversity quotient (quitter).

Based on the description above, the purpose of this research is to analyze the mistakes of prospective teacher students in solving the problem of addition and multiplication rules in combinatorics based on adversity quotient.

METHOD

In this study, the type of research is descriptive research. The research subjects were 70 student teacher candidates in the 3rd semester of Mathematics Education, Teaching and Education Faculty, Sriwijaya

University. The research was conducted online and offline in September. the selection of research subjects was based on questionnaires and recommendations from the supervising lecturer as the supervisor of the course. The material studied is related to the rules of addition and multiplication. Research data collection and analysis techniques include questionnaires or written test questionnaires and interviews. The instruments used were questionnaires and test questions. The questionnaire is aimed at grouping student teacher candidates based on the adversity quotient level.. The test questions are intended to find out the mistakes of the student teacher candidates. To analyze errors using Newman's error analysis. The Newman error indicators (Clement, 1980) can be seen in Table 1.

Table 1. Newman error indicators

No.	Error Types	Indicators
1	<i>Reading Error (RE)</i>	Students misread terms, symbols, words or important information in the problem.
2	<i>Comprehension Error (CE)</i>	a. Students do not know what is actually asked in the problem. b. The error captures the information in the problem so that it cannot complete the next process
3	<i>Transformation Error (TE)</i>	a. Students fail to change to the correct form of mathematical models. b. Students are wrong in using arithmetic operation signs to solve problems.
4	<i>Process Skill Error (PE)</i>	a. Students make mistakes in calculations or computations. b. The student does not continue the completion procedure.
5	<i>Encoding Error (EE)</i>	a. Students cannot write down the final answer required by the question. b. Students cannot conclude answers according to mathematical sentences. c. Errors due to carelessness or carelessness.

RESULTS AND DISCUSSION

In this study carried out 3 stages. The first stage is the preparatory stage. In the preparatory stage, research instruments were made and the instruments were validated by the

Sriwijaya University Mathematics Education lecturer. The second stage is the implementation stage. The research was carried out in 3 stages, namely students filling out questionnaires, tests and conducting interviews. Then the

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third stage is the final stage. Researchers analyzed the data - the data obtained. Based on the results of the study, the categories of prospective teacher students were obtained based on the level of adversity quotient can be seen in Table 2.

Table 2. Adversity quotient level category for prospective teacher students

Category	Score	Number of students
<i>Quitter</i>	$0 \leq x \leq 40$	0
<i>Camper</i>	$40 < x \leq 80$	12
<i>Climber</i>	$80 < x \leq 100$	58
Total		70

From table 2, if percentaged, it can be seen that student teacher candidates who have a Quitter type adversity quotient have 0 student teacher candidates with a percentage of 0%, Camper type adversity quotient has 58 student teacher candidates with a percentage of 82.86%, Climber type adversity quotient there were 12

prospective teacher students with a percentage of 17.14%.

After obtaining the adversity quotient, the researcher then analyzed the errors in the written test results that had been carried out by 70 prospective teacher students. The following is a written test question carried out by prospective teacher students, namely "How many numbers can be formed from the digits 1,2,3,4,5 if:

1. The number formed must be odd?
2. The number formed must be divisible by 4?
3. Odd numbers occupy even positions and even numbers occupy odd positions.?"

The analysis of student errors is guided by Newman's error indicator (Clement, 1980), by identifying what percentage for each question is for each type of error. Following is the recapitulation of the percentage results of the analysis of student answers can be seen in Table 3.

Table 3. Recapitulation of the percentage of student teacher prospective teacher error analysis results

	<i>RE</i>	<i>CE</i>	<i>TE</i>	<i>PE</i>	<i>EE</i>
Problem 1	1	2	2	2	2
Problem 2	1	15	19	16	16
Problem 3	0	3	3	3	4
Total	0	20	24	21	22
Percentage	0,95%	28,57%	34,29%	30%	31,43%

The results of data analysis show that the average percentage of reading errors is 0.95%. The following is the result of the work of prospective teacher students (Camper type adversity quotient) who completed questions that made mistakes in Reading Errors, which can be seen in Figure 1.

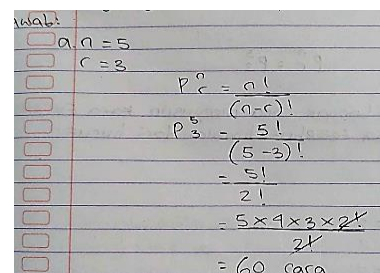


Figure 1. Results of subject S13's work (Camper type adversity quotient) on question number 1.

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Based on interviews that have been conducted with subject S13, it shows that the student teacher's error occurred because the prospective teacher student misread terms, symbols, words or important information in the problem, that is, students used the permutation rule which should have used the addition and multiplication rules. This is in accordance with the statement of Clement (1980) about students' ability to read will affect how to solve problems.

The results of data analysis show that the average percentage of Comprehension Error is 28.57%. The following is the result of the work of prospective teacher students (Climber type adversity quotient) who completed questions that made mistakes in Comprehension Errors, which can be seen in Figure 2.

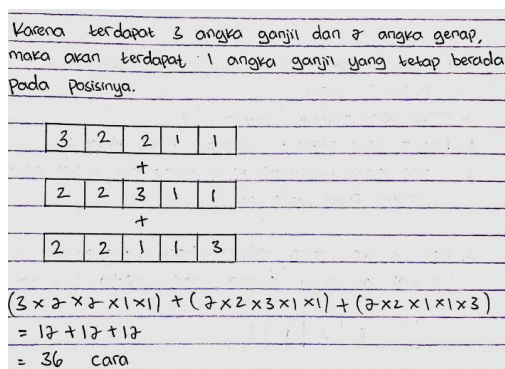


Figure 2. Results of subject S52's work (adversity quotient type Climber) question number 3

Based on interviews that have been conducted with subject S52, shows that the student teacher's error occurred due to an error in capturing the information in the question "then there will be 1 odd number that remains in its position" it should be "based on the information in the question, the placement of odd numbers is in an even position which means there are many

numbers odd numbers are in order 2 and 4 and the placement of even numbers is in odd positions, which means that the number of even numbers is in order 1, 3 and 5. Similar to the results of Oktoviani et al. (2019) students who do not understand the meaning of the questions are the cause of misunderstanding the questions.

The results of data analysis show that the average percentage of Transformation Error is 34.29%. The following is the result of the work of prospective teacher students (Camper type adversity quotient) who completed questions that made mistakes in Comprehension Errors, which can be seen in Figure 3.

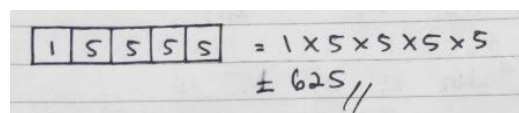


Figure 3. The results of the work of subject S30 (camper type adversity quotient) for question number 2

Based on interviews that have been conducted with subject S30, shows that student errors occur because students fail to convert to the correct form of the mathematical model. The subject's error is the way the transformation is reversed, [1, 5, 5, 5, 5] it should be [5, 5, 5, 5, 1]. This was reinforced by (Mahmudah, 2018) who in his research concluded that misunderstandings and transformation errors were more dominant than other types of errors. In addition, it was reinforced by Magfirah et al. (2019)

Transformation errors were caused because students could not remember formulas, used formulas incorrectly, designed formulas that were not appropriate, used formulas that were inverted, interpreted questions incorrectly, were not used to working

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on material story problems surface area of flat side shapes, less mastery of material due to lack of reviewing material that has been obtained

The results of data analysis show that the average percentage of Process Skill Error is 30%. The following are the results of the work of prospective teacher students (Climber type adversity quotient) who completed questions that made mistakes in Comprehension Errors, which can be seen in Figure 4.

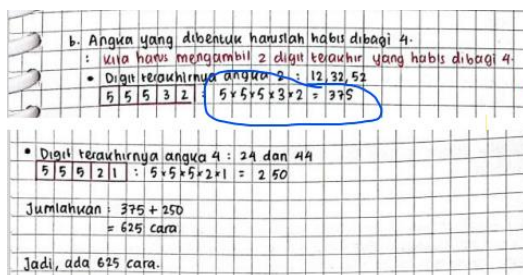


Figure 4. The results of subject S15's work (Camper type adversity quotient) on question number 2.

Based on interviews that have been conducted with subject S15, shows that student errors occur because students make mistakes in calculations or computations. The subject error is that what is contained in the image should be $5 \times 5 \times 5 \times 3 \times 1 = 375$, subject S15 has the correct answer but the subject

Table 4. Analysis of Student Teacher Prospective Errors based on Newman Indicators and Adversity Quotient

	RE	CE	TE	PE	EE
Camper	√	√	√	√	√
Climber		√	√	√	√

Subjects in the Climber category when solving addition and multiplication rules questions made 4 types of errors, namely CE, TE, PE and EE. Subjects with the Camper category when solving addition and multiplication rule questions made 5 types of errors, namely RE, CE, TE, PE and EE.

writes incorrectly $5 \times 5 \times 5 \times 3 \times 2 = 375$, while $5 \times 5 \times 5 \times 3 \times 2$ the result is not 375. After being interviewed subject S15 wrote incorrectly which number 2 is number 1.

The results of data analysis show that the average percentage of Encoding Error is 31.43%. The following is the result of the work of prospective teacher students (Camper type adversity quotient) who completed questions that made mistakes in Comprehension Errors, which can be seen in Figure 5.

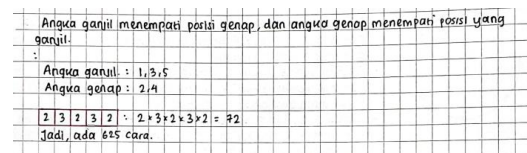


Figure 5. The results of the work of subject S15 (camper type adversity quotient) question number 3.

Based on interviews that have been conducted with subject S15, shows that student errors occurred due to writing inappropriate final answers, namely writing "so, there are 625 ways" instead of "so, there are 72 ways". These errors are due to carelessness or inaccuracy, even though the process skills are correct.

Errors are measured based on newman indicators, described as follows:

First, reading errors in student teacher candidates. Based on the results of the analysis, reading error is the one with the least percentage. Students make mistakes because there are students who still don't understand

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symbols, terms, words and important information in the questions. This is in line with the explanation Clement (1980) regarding students' ability when reading will affect efforts to solve these problems. Then, based on Yusnia (2017) revealed that the fewest errors made by the subject were reading errors.

Second, Comprehension Error in student teacher candidates. Based on the results of the analysis, this is because prospective teacher students are not careful when understanding the questions and are incomplete in writing down the information and questions in the questions. in line with what was expressed by Yusnia (2017), which revealed that the mistakes made by someone in Comprehension Error were not careful when writing down the information contained in the problem. In addition, according to research results Oktoviani et al. (2019) the cause of student errors in understanding the questions was because they did not understand the intent of the questions. And also in accordance with this study, namely that there were prospective teacher students who were unable to determine what was asked or ordered to write down the information in the problem.

Third, Transformation Error on student teacher candidates. The cause of the error was that prospective teacher students did not master the questions and were not able to determine mathematical models and arithmetic operations when solving problems. This is in line with Magfirah et al. (2019) who revealed that the cause of the transformation error was due to the use of an inverted mathematical model, which was not appropriate when designing the formula or mathematical

model and was not precise in interpreting the problem.

Fourth, Process Skill Error on student teacher candidates. the cause of the Process Skill Error is that prospective teacher students make mistakes in the previous indicators and prospective teacher students are not careful in carrying out arithmetic operations. This is in line with research Suyitno & Suyitno (2015) which says that a person often makes mistakes due to carelessness, lack of thoroughness and loss of focus when solving problems.

Fifth, Encoding Error on student teacher candidates. Most student teacher candidates make mistakes at the encoding error stage because students make mistakes first on previous indicators such as Comprehension Error, Transformation Error, Process Skill Error. This research is in line with Fuadi & Sutriyono (2018) which revealed that a person made a mistake in the previous indicator section which is the reason that a lot of people do it in the encoding section.

CONCLUSION DAN SUGGESTION

Based on the research that has been done, it can be concluded that student teacher candidates who have a Quitter type adversity quotient are 0 student teacher candidates with a percentage of 0%, Camper type adversity quotients are 58 student teacher candidates with a percentage of 82.86%, Climber type adversity quotient is 12 student teacher candidates with a percentage of 17.14%. As well as prospective teacher students in the Adversity quotient category of the Climber type, they made 4 mistakes according to Newman's procedure, namely Comprehension Error, Transformation Error, Process Skill

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Error and Encoding Error. Student teacher candidates in the adversity quotient category of Camperr type made 5 mistakes according to Newman's procedure, namely Reading Errors, Comprehension Errors, Transformation Errors, Process Skill Errors and Encoding Errors.

The suggestion from this researcher is that other researchers can examine it more deeply with different reviews.

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