
**STUDENTS' ERRORS IN SOLVING MATHEMATICS ESSAY QUESTIONS ACCORDING TO
WATSON**

(A Qualitative Study on Exponents for Grade VIII Students at MTs Negeri 1 Tegal Regency)

Afifudin Rajif Noersy¹, Munadi², Ibnu Sina³
afifudinrajif@upstegal.ac.id

Abstract

This study aimed to identify specific errors and the most dominant errors made by students in answering mathematics essay questions on the topic of exponents based on Watson's criteria. The method used was descriptive qualitative research with purposive sampling. The sample consisted of six students, namely four males and two females, from the advanced class at MTs Negeri 1 Tegal Regency in the 2025/2026 academic year. The instruments used to obtain data were essay questions, direct interviews, and documentation. The findings indicate that the types of errors identified included 8 categories: inappropriate procedure (ip), omitted conclusion (oc), response level conflict (rlc), undirected manipulation (um), skills hierarchy problem (shp), and errors other than the seven categories above (above other/ao). The most dominant errors were inappropriate procedure (ip) and errors other than the seven categories above (above other/ao). No inappropriate data (id) or omitted data (od) errors were found. The main contributing factors were a lack of understanding of the concept of exponents, lack of precision, and the habit of rushing when solving problems.

Keywords: error analysis; mathematics essay questions; Watson's theory; exponents;

A. INTRODUCTION

Mathematics is one of the subjects that poses a particular challenge for many students in Indonesia. Students' low level of mastery in solving mathematical problems, especially essay-type questions, has become a serious concern in education. Essay questions require students not only to provide a final answer but also to present their thinking process systematically and in a structured manner.

Based on data obtained through observations and question-and-answer sessions conducted at MTs Negeri 1 Tegal Regency, it was found that Grade VIII students made many errors when answering mathematics essay questions on the topic of exponents. These errors included an inability to understand concepts, difficulties in applying formulas, lack of accuracy in calculations, and difficulties in organizing answers systematically (Susanto, 2016).

Student error analysis is an important step in evaluating mathematics learning. By identifying the location and type of errors, teachers can design more targeted learning interventions. One comprehensive instrument for error analysis is Watson's Error Category (Ayarsha, 2016).

Watson classified student errors into eight categories, namely:

undirected manipulation (um), omitted data (od), skills hierarchy problem (shp), omitted conclusion (oc), inappropriate data (id), response level conflict (rlc), inappropriate procedure

(ip), and errors other than the seven categories above (above other/ao). The advantage of Watson's theory lies in its ability to identify the location of errors specifically, making it highly suitable for analyzing mathematical word problems or essay questions (Nurul Munawaroh et al., 2018).

Several relevant studies support the use of Watson's theory in error analysis. Nuroniah (2013) found that the dominant errors among junior high school students were inappropriate procedure (ip) and inappropriate data (id). Ayarsha (2016) found that errors other than the seven categories above (above other/ao) and response level conflict (rlc) dominated in both public and private schools. Hariyanto (2025) showed that omitted conclusion errors reached 100% on HOTS questions.

Based on this background, this study aimed to: (1) describe the categories of students' errors in answering essay questions on the topic of exponents based on Watson's theory, and (2) identify the most dominant errors and the factors influencing them.

B. RESEARCH METHOD

Using a descriptive qualitative method, this study was able to gain an in-depth understanding of the types and root causes of errors in answering mathematics essay questions (Sugiyono, 2020). This qualitative study was conducted at Madrasah Tsanawiyah Negeri 1 Tegal Regency in November 2025.

The sample was selected using purposive sampling, resulting in six students from the advanced class. The selection of subjects considered the representation of variation within the advanced classes. The six students consisted of four males and two females who represented the IBS (Islamic Boarding School) class and the Main class.

The research instruments included: (1) a written test consisting of five essay questions on exponents, developed from the Grade VIII MTs Mathematics Student Book for Semester 1 of the Merdeka Curriculum; (2) a semi-structured interview guide to explore the causes of errors; and (3) documentation sheets consisting of students' answer sheets. The test instrument and interview guide had been validated by two expert validators before use.

Data collection was carried out in three stages. First, a written test was administered on November 15, 2025. Second, interview subjects were selected based on the results of the test analysis. Third, interviews were conducted on November 19, 2025, to confirm and deepen information regarding the errors made.

Data analysis was conducted through the following stages: (1) examining students' answer sheets, (2) identifying and classifying errors based on Watson's eight categories, (3) conducting interviews, (4) describing and interpreting the data, and (5) drawing conclusions. Data validity was obtained through three methods: written tests, interviews, and documentation.

C. RESULTS AND DISCUSSION

1. Student Error Profile

Analysis of the answers of the six research subjects to five essay questions on exponents resulted in an error mapping based on Watson's eight categories. A recapitulation of the findings is presented below.

Table 1. Recapitulation of Student Errors According to Watson's Categories

Code	Error Type	Subjects Committing the Error	Subject Frequency
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ip	Inappropriate Procedure	PD1 (question 4), PD3 (question 1), PD5 (questions 3, 4), PD6 (question 5)	4
oc	Omitted Conclusion	PD1 (question 3), PD4 (question 4), PD6 (question 3)	3
rlc	Response Level Conflict	PD2 (question 3)	1
um	Undirected Manipulation	PD3 (question 4)	1
shp	Skills Hierarchy Problem	PD2 (question 4)	1
ao	Above Other	PD1, PD2, PD3, PD4, PD5, PD6 (various questions)	6
id	Inappropriate Data	-	0
od	Omitted Data	-	0

Source: Research data, 2025

2. Description of Errors Based on Watson's Categories

a. Inappropriate data/id (inappropriate data)

Based on the analysis of all answer sheets from the six research subjects, no errors in the inappropriate data (id) category were found. This indicates that students were generally able to understand and identify the information provided in the questions well, although they experienced difficulties during the solution process.

b. Omitted data/od (omitted data)

Omitted data (od) errors occur when students do not write, omit, or fail to identify one or more important pieces of information (data) that should be known or used when solving a problem. The analysis of all answer sheets from the six research subjects found no errors in the omitted data (od) category.

c. Inappropriate procedure/ip (inappropriate procedure)

Inappropriate procedure errors were found most frequently. These errors occurred when students did not follow the correct steps or algorithms in answering the questions. Four of the six research subjects (PD1, PD3, PD5, and PD6) were found to have committed this type of error.

An example was found in PD1's response to question number 4: $48 = 3()$ = was solved by directly multiplying coefficient 3 by , resulting in . The correct rule is that the coefficient and the exponent term are different types of quantities and therefore cannot be multiplied directly.

Based on the interview results, PD1 stated that they equated ordinary multiplication operations with multiplication involving exponential numbers. This finding is similar to the study by Hariyani et al. (2019), which also concluded that procedural errors dominated in problems involving exponents.

d. Omitted conclusion/oc (omitted conclusion)

Omitted conclusion errors were found in three subjects (PD1, PD4, and PD6). This error occurs when students have carried out the calculation process correctly but do not explicitly write the final conclusion that answers the question.

For question number 3: $4 + = 8$. PD6 successfully calculated correctly up to the line $4 + 4 = 8$, but stopped without writing the conclusion $x = 14$. The student considered the final calculation result sufficient without needing a concluding statement that directly answered the main question.

e. Response level conflict/rlc (response level conflict)

A response level conflict was found when subject PD2 answered question number 3: $4 + = 8$. PD2 initially carried out the correct steps, but at the end made a conclusion that was irrelevant to the preceding process, namely writing $x = 8 + 2 + 4 = 14$ without a logical correlation with the previous steps. This occurred because the student did not have a complete understanding of the flow of the solution, resulting in an inconsistent conclusion.

f. Undirected manipulation/um (undirected manipulation)

An undirected manipulation (um) error was found in PD3's response to question number 4. The student performed an illogical calculation by directly changing $3(2n) = 48$ into $9n = 48$, then concluding $n = 48 - 9$. The student combined coefficient 3 with $2n$ to obtain $9n$ without a valid basis in the rules of exponents.

g. Skills hierarchy problem/shp (skills hierarchy problem)

A skills hierarchy problem was found in subject PD2's response to question number 4. This error was related to the student's inability to master the prerequisite skills needed to solve problems involving exponents.

In question number 4, PD2 made an error when calculating the multiplication of a coefficient by an exponential term: the problem, the answer became . The multiplication on the right-hand side was incorrect, becoming . The student had not mastered the rule for multiplying coefficients by exponential terms; an error at one step or procedural stage would hinder the subsequent step.

h. Above other/ao (other than the seven categories above)

The above other (ao) category was the most evenly distributed error, occurring in all six research subjects. The most common form of error was failing to write the words "Known," "Asked," and "Answer" on the answer sheet. In addition, some students did not answer certain questions within the allotted time.

Although this error is not directly related to students' understanding of mathematical concepts, it reflects undisciplined and unstructured problem-solving habits. Students were not yet accustomed to presenting answers to essay questions systematically.

3. Factors Causing Errors

The results of in-depth interviews with all research subjects identified the main factors contributing to the occurrence of errors. First, there was a lack of understanding of the basic concepts of exponents, particularly the properties of multiplication and division operations involving exponents. Students tended to memorize formulas without understanding their conceptual meaning, making them easily confused when presented with questions in slightly different forms.

Second, lack of precision in calculations caused students to make errors in technical steps even though they conceptually understood the solution process. Third, the habit of rushing to complete the questions, particularly with regard to writing conclusions and completing the answer format. Fourth, limited practice with essay questions meant that students were not accustomed to presenting answers systematically and in a structured manner.

4. Comparison with Relevant Studies

The findings of this study are consistent with several previous studies. Nuroniah (2013) found that the inappropriate procedure (ip) and inappropriate data (id) categories dominated at

SMP IT Bina Amal, whereas this study found no inappropriate data (id) errors and identified inappropriate procedure (ip) as the most dominant. This difference may be caused by differences in the characteristics of the material and students' basic ability to read and interpret questions.

Hariyani et al. (2019) found that procedural and procedural-skill errors dominated in word problems, which is consistent with the findings of this study. Munawaroh et al. (2018) concluded that inappropriate data and inappropriate procedure errors dominated in junior high school students' mathematical communication questions, which is partly consistent with the findings of this study for the ip category.

In general, the error patterns found indicate that students at MTs Negeri 1 Tegal had relatively good abilities in reading and identifying the data in questions (no id or od errors), but were still weak in applying procedures and writing conclusions. This provides useful information for teachers in designing learning processes that emphasize procedural understanding and the habit of writing correct conclusions.

D. CONCLUSION

The discussion led to the following conclusions. First, the types of errors in answering essay questions on exponents according to Watson's theory included inappropriate procedure (ip), omitted conclusion (oc), response level conflict (rlc), undirected manipulation (um), skills hierarchy problem (shp), and errors other than the seven categories above (above other). No inappropriate data (id) or omitted data (od) errors were found.

Second, the most prominent error types were inappropriate procedure (ip), identified in 5 of the 6 subjects, and errors other than the seven categories above (above other/ao), which were indicated in all 6 subjects. The main factors causing these errors were limited understanding of exponents, lack of accuracy in calculations, and insufficient habit of solving problems systematically.

Third, the analytical approach based on Watson's theory proved effective in identifying the specific locations of students' errors when answering mathematics essay questions. This conclusion is expected to serve as a guide for teachers in planning appropriate remedial sessions, particularly to strengthen procedures for operations involving exponents and to develop the habit of writing structured answers.

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