

Common errors analysis in solving fractional number problems reviewed from Newman's theory

Soffi Widyanesti*, Vina Monica, Nabila Atika Fauzia, & Larasati

Universitas Ahmad Dahlan, Jl. Jend. Ahmad Yani, Tamanan, Banguntapan, Bantul,
DIY 55191 Indonesia

*Corresponding e-mail: soffiwidyanesti@pmat.uad.ac.id

Abstract

This research aims to describe common mistakes made by students in calculating fractional numbers, especially in comparing fractional numbers. For this reason, an analysis of the mistakes made by students is required. The subjects in this research were three students of SMP Muhammadiyah 1 Godean who were taken after fulfilling the requirements for selecting research subjects. Test and observation methods are the methods for collecting data. The data analysis technique used in this research is Newman's theory, of which there are 5 stages, namely: (1) reading stage, (2) understanding stage, (3) transformation stage, (4) process skills stage, and (5) Answer Writing Stage. This research shows that the errors made by students in general are: (1) Errors in reading and understanding questions, (2) Errors in reading mathematical comparison symbols, (3) Errors in changing the form of images presented to fractional numbers, and (4) Errors in calculating the LCM value between two denominators.

Keywords: error analysis, comparing fractions, newman's theory.

How to cite: Widyanesti, S., Monica, V., Fauzia, N. A., & Larasati. (2023). Common errors analysis in solving fractional number problems reviewed from newman's theory. *International Journal on Education Insight*, 4(2), 65-72. DOI: 10.12928/ije.v4i2.10291

Article history: Received February 20, 2023; Revised September 1, 2023; Accepted September 30, 2023

INTRODUCTION

Nowadays, there are many problems in everyday life. Where this problem is not only a mathematical problem. However, mathematics has a very important role in solving problems, especially in solving problems that have no formula and are of course very different in life. This means showing that mathematics is the main thing that everyone must learn (Syahril & Kartini, 2021). Therefore, mathematics is a mandatory subject taken from kindergarten to tertiary education.

Mathematics is a science that is studied through a reasoning process and is centered on the human mind which is related to ideas, processes, and also reasoning. The presentation or disclosure of mathematics material in schools is adjusted to the estimated intellectual development of students. This is done by relating the material to be delivered to the real world or adapting it to existing use (DEAS, 1960).

The material of comparing fractions is one part of mathematics that has an important role in life. This is because comparing fractions is the basis of mathematical operations related to addition, subtraction, multiplication, and division. Thus, understanding the material on comparing fractions will form mathematical skills that have an impact on everyday life and can help in developing thinking and problem-solving abilities.

Based on the results of observations at the internship program at SMP Muhammadiyah 1 Godean, students tend to have difficulty solving mathematics problems due to difficulty understanding concepts, especially those relating to daily life, lack of practice and lack of student motivation towards learning mathematics. Apart from that, another mistake that affects students is the lack of understanding of basic concepts in fraction material, where there are students who do not understand the prerequisite material for fractions, namely KPK, which should have been received and mastered in elementary school. Seeing the importance of the material comparing fractions, an error analysis stage is needed so that students can find out the types of errors. This analysis activity can use techniques from Newman's theory.

Based on Newman's error theory, the types of errors in solving mathematical problems are grouped into 5, namely (1) student errors in reading questions or problems. This occurs when students read the questions given and do not use the information provided so they do not achieve the goal. Existing problems (2) errors in understanding the problem, occur when students do not understand the concept and do not know what is meant in the problem or conclude wrong information so they cannot solve the problem, (3) errors in transforming the problem, which occurs when students change the problem into mathematical form and students also use mathematical symbols incorrectly, (4) skills and process errors, which occur when students are less skilled in carrying out the process calculations, and (5) errors in writing answers, which occur when concluding the requested answer (Haryati et al., 2016)

Studies on error analysis based on Newman's theory have been carried out by several researchers, including a study (Mahmudah, 2018) examining what errors students in class VIII-G of SMP Negeri 1 Gesik made in solving hot-type math problems based on Newman's theory. Comprehension and transformation errors are the most common errors, according to the results of his study.

Based on the explanation above, the researcher wishes to analyze students' common mistakes in solving fraction comparison problems in class VII in terms of Newman's theory. It is hoped that this research will provide more in-depth information about the analysis of students' common mistakes in comparing fractions that have occurred in Muhammadiyah 1 Godean Middle School. The aim is to provide an overview of the types of errors students make in solving fraction comparison problems

RESEARCH METHOD

In this research, researchers used qualitative research. This research focuses on the conditions of natural objects, where the researcher is the main tool. There are several data collection methods used in this research, including written tests, documentation, observation, and qualitative descriptive data analysis. This research aims to explain a phenomenon in depth by collecting data in detailed forms of the data being studied.

This time the research was carried out on class VII A students of SMP Muhammadiyah 1 Godean which coincided with the odd semester. The main subjects in this research were 3 students. This research collected data through the following methods: 1) Written tests given to students who had previously studied material about fraction comparison; 2) Record the results of students' answers; and 3) Seeing how students work on questions. This study uses five essay questions with the main material discussing fraction comparisons.

Error analysis and corrections will be carried out on data from students' written tests. Mistakes that are often made will be used as clues to help

minimize the learning process in the future. Qualitative data will be described in written words. The data validity technique used in this research is the triangulation method. This method is a verification technique that uses external information as additional or comparative material.

The following are the questions given by researchers in this study (See Figure 1).

1. Monica mempunyai tali sepanjang $\frac{1}{4}$ dan ara mempunyai tali yang sama dengan panjang $\frac{1}{10}$. Siapakah yang memiliki tali terpanjang antara Monica dan Ara?
2. Perhatikan gambar semangka dibawah ini!



Tuliskan nilai pecahan pada masing-masing gambar lalu bandingkan pecahan yang ada pada gambar tersebut!

3. Donni memberikan $\frac{1}{6}$ bagian pizzanya ke Dion dan $\frac{1}{2}$ ke Yunan. Siapa yang memiliki pizza lebih besar diantara keduanya?
4. Pada suatu hari, Budi dan 2 orang teman lainnya bermain di taman. Lalu budi memberikan $\frac{1}{9}$ bagian kelerengnya kepada Chandra, $\frac{4}{3}$ kepada ahmad dan $\frac{2}{5}$ bagian lagi terhadap Fakhri. Lalu carilah teman budi yang mendapatkan kelereng paling sedikit!
5. Ahmad membeli tepung terigu sebanyak $\frac{1}{4}$ kg, kemudian Ahmad membeli beras sebanyak $\frac{6}{8}$ kg. Coba bandingkan antara tepung terigu dan beras yang Ahmad beli! Manakah yang beratnya lebih besar?

Figure 1. Sample problems

After students work on the questions above, students' answers will be grouped based on errors referring to research. The determination of the 3 students was carried out randomly where the n students selected were students who worked on written questions comparing fractions but made a lot of mistakes. The following is data on forms of student errors based on Newman's theory.

Table 1. Data on forms of student errors based on Newman's theory

No	Forms of Student Mistakes	Student Initials
1	Errors in reading the questions, including students making mistakes in determining and collecting known fraction information in the questions.	DAS, APP, and RYU
2	Mistakes in understanding existing problems, including students misunderstanding the meaning of the question so that students conclude the wrong information and do not solve the problem	RYU, APP, and DAS
3	Students' mistakes in transforming story problems or pictures, including students making mistakes in using symbols less than or more than the mathematical symbols, namely "<" and ">"	DAS, APP, and RYU
4	Student errors in process skills include students not being careful in determining the KPK from a specified number	APP, DAS, and RYU
5	Students' mistakes when writing answers include students making mistakes in concluding the final answer or conclusion of a problem	DAS, RYU, and APP

RESULTS AND DISCUSSION

Results

This time the researcher gave a test comparing fractions to 28 class VII students of SMP Muhammadiyah 1 Godean. The test given to n students consists of 5 questions. The selected subject is an answer that can represent all errors. The subjects selected as informants in this research were APP, RYU, and DAS. The student's answer to question number 1 is DAS because n mistakes made by DAS can represent n other mistakes. Below, DAS's answer to question number 1 can be seen in Figure 2.

Soal
 1) Monica mempunyai tali sepanjang $\frac{1}{4}$ dan ara mempunyai tali yg sama dengan panjang $\frac{1}{10}$ siapa yg memiliki tali terpanjang antara ~~Monika~~ Monica dan ara?
 Penyelesaian:
 Diketahui = Panjang tali monika $\frac{1}{4}$
 Panjang tali ara $\frac{1}{10}$
 Ditanya : tali siapa yg paling panjang?
 jawaban =
 $\frac{1}{4} > \frac{1}{10}$
 KPK dari 4 dan 10 adalah
 $4 = 4, 8, 12, 16, 20$
 $10 = 10, 20, 30, 40$
 $\frac{1 \times 5}{4 \times 5} = \frac{5}{20}$
 $\frac{1 \times 2}{10 \times 2} = \frac{2}{20}$
 maka $\frac{1}{4}$ lebih kecil dari $\frac{1}{10}$
 tali monika lebih pendek dari tali ara

Figure 2. Sample solution of DAS

DAS made a mistake in the conclusion section, where DAS wrote that Monica's rope was shorter or smaller than Ara's rope. In fact, in determining the mathematical comparison symbol, DAS answered correctly that Monica's rope, namely $\frac{1}{4} > \frac{1}{10}$ from Ara's rope. Apart from that, DAS did not conclude correctly regarding the answer, where DAS concluded that the rope was shorter while the question was who had the longest rope.

For the error in question number 2, it is the answer from RYU and DAS because n errors made by RYU can represent n other errors. Below, RYU's answer to question number 2 can be seen in Figure 3.

RYU made a mistake in writing the fractions in both pictures. RYU stated that the picture on the left is $\frac{2}{3}$ and for the picture on the right, $\frac{1}{4}$ RYU should have successively written the fractions as $\frac{1}{3}$ and $\frac{3}{4}$ which resulted in the process of writing the wrong conclusion as well as the result of incorrectly determining the fractions in the picture. Meanwhile, in DAS, he also made the same mistake, namely incorrectly determining the fractions in the picture.

2. Diket = Gambar 1 = $\frac{2}{3}$
 --||-- 2 = $\frac{1}{4}$

Ditany = Bandingkan gambar 1 dengan gambar 2.
 Jawab = $\frac{2}{3} > \frac{1}{4}$

Cara = Cari KPK dari 3 dan 4

$3 = 3 \times 1$ $4 = 2 \times 2 = 2^2$

$\begin{matrix} 3 \\ \textcircled{3} \end{matrix}$ $\begin{matrix} 4 \\ \textcircled{2} \end{matrix}$

= Jadi KPK dari 3 dan 4 adalah $2^2 \times 3 \times 1 = 12$

NOTEBOOK

GREDEL

$\frac{2 \times 4}{3 \times 4} = \frac{8}{12}$ } Jadi Perbandingan antara gambar 1 dan gambar 2 adalah

$\frac{1 \times 3}{4 \times 3} = \frac{3}{12}$ } $\frac{8}{12} > \frac{3}{12}$

3. Dikeetahui : gambar 1 dan 2
 gambar 1 = $\frac{2}{3}$
 gambar 2 = $\frac{1}{3}$
 jawab : $\frac{2}{3} < \frac{1}{3}$
 KPK dari 1 dan 3

Dipindai dengan Cam

Figure 3. Sample solution of RYU

Mistake number 3 is the result of work from RYU and APP because n mistakes made n can represent n other mistakes. The following are RYU and APP's answers to question n number 3 which can be seen in figure 4.

3. Diket = - Bagian pizza Dion = $\frac{1}{6}$
 - -||- -||- Yunon = $\frac{1}{2}$

Ditany = Siapakah yang mendapat bagian pizza lebih besar?

Jawab = $\frac{1}{6} > \frac{1}{2}$

Cara = Cari KPK dari 6 dan 2

$6 = 2 \times 3$ $2 = 2 \times 1$

$\begin{matrix} 6 \\ \textcircled{2} \end{matrix}$ $\begin{matrix} 2 \\ \textcircled{2} \end{matrix}$

= Jadi KPKnya adalah $2 \times 3 = 6$

$\frac{1 \times 1}{6 \times 1} = \frac{1}{6}$ } yang mendapat pizza bagian terbesar adalah

$\frac{1 \times 3}{2 \times 3} = \frac{3}{6}$ } $\frac{1}{6} > \frac{3}{6}$

Dipindai dengan C

3. Diketahui : - Pizza Dion = $\frac{1}{6}$
 - Pizza Yunon = $\frac{1}{2}$

Ditanya = Siapa yang memiliki pizza paling besar?

Dijawab = $\frac{1}{6} < \frac{1}{2}$

KPK dari 6 dan 2 adalah

$6 = 2 \times 3$ $2 = 2 \times 1$

$\begin{matrix} 6 \\ \textcircled{2} \end{matrix}$ $\begin{matrix} 2 \\ \textcircled{2} \end{matrix}$

UNIVERSITY OF CALIFORNIA LOS ANGELES

No: _____ Date: _____

Jadi kpk dari 6 dan 2 adalah $2 \times 3 = 6$

$\frac{1}{6} = \frac{1}{6}$ } Jadi Dion dan Yunon memiliki bagian pizza yang sama

$\frac{1}{2} = \frac{1}{6}$ } $\frac{1}{6} = \frac{1}{2}$

Figure 4. Sample solution of RYU and APP

In Figure 4.1, RYU made errors in mathematical symbols in the process and the conclusions. RYU wrote $\frac{1}{6} > \frac{1}{2}$ what RYU should have written $\frac{1}{6} < \frac{1}{2}$. However, RYU was correct in determining the KPK and writing its written conclusions. Meanwhile, the APP in Figure 4.2 appears to have made an error in its multiplication calculation, where if the denominator is multiplied by 3 then the numerator must also be multiplied by 3, causing errors in concluding.

Mistake number 4 is the answer from DAS and APP because n mistakes made can represent other mistakes. The following DAS and APP answers to question number 4 can be seen in Figure 5.

4. Diketahui : kelereng Budi $\frac{1}{9}$
 - kelereng Ahmad $\frac{4}{3}$
 - kelereng Fakhri $\frac{2}{5}$

Ditanya : kelereng siapa yg paling sedikit?

Jawab = $\frac{1}{9} \dots \frac{4}{3} \dots \frac{2}{5}$

KPK dari 9, 3 dan 5 adalah 45

$9 = 9, 18, 27, 36, 45, 54, 63$

$3 = 3, 6, 9, 12, 18, 21, 24, 27, 30, 33, 36, 39, 42$

$5 = 5, 10, 15, 20, 25, 30, 35, 40, 45, 50$

$\frac{1 \times 5}{9 \times 5} = \frac{5}{45}$

$\frac{4 \times 15}{3 \times 15} = \frac{60}{45}$

$\frac{2 \times 9}{5 \times 9} = \frac{18}{45}$

Jadi kelereng yg paling sedikit adalah $\frac{5}{45}$ atau $\frac{1}{9}$ pada Budi

4. Diketahui = Kelereng chandra = $\frac{1}{9}$
 - kelereng Ahmad = $\frac{4}{3}$
 - Kelereng Fakhri = $\frac{2}{5}$

Ditanya : Siapakah yang mendapat kelereng paling sedikit?

Dijawab = KPK dari 9, 3, 5 adalah

$9 = 3 \times 3 = 3^2$ $3 = 2 \times 2 \times 2^2$ $5 = 5 \times 1$

Jadi KPK dari 9, 3, dan 5 adalah = $3^2 \times 2^2 \times 5$
 = 180

Jadi yg mendapat kelereng paling sedikit adalah Fakhri = yaitu $\frac{2}{5}$

$\frac{1}{9} \times \frac{20}{20} = \frac{20}{180}$

$\frac{4}{3} \times \frac{45}{45} = \frac{180}{180}$

$\frac{2}{5} \times \frac{36}{36} = \frac{72}{180}$

Figure 5. Sample solution of DAS and APP

To work on question number 4, the DAS students made n mistakes in collecting the information they received, Budi should have just given the marbles to his friend so that the value of the fraction $\frac{1}{9}$ belonged to Chandra. Meanwhile, in the APP, he made a mistake in writing the value of the fraction, which is $\frac{3}{4}$ what it should be, $\frac{4}{3}$ so this caused a calculation error for the least common multiple and the conclusion of the answer.

For question number 5, the APP answer is because most students make many of the same mistakes, so the APP answer can represent the mistakes of

other students. The following is the APP's answer to question number 5 which can be seen in figure 6.

Diketahui = - Tepung Terigu = $\frac{1}{4}$
 - Beras = $\frac{6}{8}$
 Ditanya = Manakah yang beratnya lebih besar?
 Dijawab = $\frac{1}{4} >> \frac{6}{8}$
 KPK dari 4 dan 8
 $4 = 2^2$ $8 = 2 \times 2 \times 2$
 jadi KPK dari 4 dan 8 adalah = $2^2 \times 2 \times 2 = 32$
 $\frac{1}{4} \times 8 = \frac{2}{1}$
 $\frac{6}{8} \times 4 = \frac{3}{1}$
 jadi antara Tepung Terigu dan beras yg
 dibeli Ahmad. Yuran beratnya lebih besar
 yaitu beras
 $\frac{1}{4} < \frac{6}{8}$

Figure 6. Sample solution of APP

APP made an error in determining the KPK value of 4 and 8. APP wrote the LCM n of 4 and n 8 32 which should be 8. APP received a KPK score of 32 due to a prime factorization error of 8, which 4×2 should be 2^3 , thus causing continued errors in determining the ratio between $\frac{1}{4}$ and $\frac{6}{8}$.

Discussion

Based on data analysis test results and documentation, it was found that errors were made by students in solving problems related to the material comparing fractions. Mistakes in reading questions made by students are: (a) Students are not careful in reading questions from the questions, which causes wrong conclusions to be drawn, (b) Students are not able to collect the information presented through story questions or pictures. This is done by APP and DAS. DAS students make mistakes in reading both questions and even the information they receive, which results in the answers and conclusions given. One of them is that in number 1 he concluded about the shortest rope while the question was about the longest. Meanwhile, APP cannot write down the fractions presented in the picture in question number 2, so the ability to read fractions in the picture is still lacking. APP states that comparison Figure 2 is $\frac{1}{4}$ where APP should write the fraction as $\frac{3}{4}$.

Mistakes in understanding the questions made by students are: (a) Students do not understand what is being asked in the question, causing errors to continue in the process. This is done by students with the initials DAS. DAS made a mistake in the conclusion section, where DAS wrote that Monica's rope was shorter or smaller than Ara's rope. In fact, in determining the mathematical comparison symbol, DAS answered correctly that Monica's rope, namely $\frac{1}{4} >$ $\frac{1}{10}$ from Ara's rope.

Mistakes in transforming questions made by students are: (a) Students are unable to change story problems or questions presented in pictures into

mathematical form. This was done by students with the initials DAS and RYU, where DAS made a mistake in determining the shaded part of the image for the comparison question. DAS wrote $\frac{1}{2} \dots \frac{1}{3}$ which DAS should write $\frac{1}{3} \dots \frac{3}{4}$ while RYU made mistakes in mathematical symbols in the process and the conclusions. RYU wrote $\frac{1}{6} > \frac{1}{2}$ what RYU should have written $\frac{1}{6} < \frac{1}{2}$

Mistakes in the skills and processes that are carried out by students are: (a) Students in solving questions are less careful in determining the LCM (b) Students do not understand the concept of factorization in determining the LCM, (c) Students are still mistaken in doing so. multiplication calculations. One of them is carried out by APP. Where APP made a mistake in determining the LCM value of 4 and 8. APP wrote the LCM n of 4 and 8 n which 32 should be 8.

Mistakes in writing answers made by students are: (a) Students are not able to understand the concept of the symbols "<" and ">" in fraction material, which causes students to make mistakes in concluding the answer to a problem, (b) Most students make mistakes in writing and concluding their answers because of mistakes made from the start of the work. One of these is carried out by DAS. DAS made a mistake in the conclusion section, where DAS wrote that Monica's rope was shorter or smaller than Ara's rope, which was the opposite of the question.

CONCLUSION

The results and discussion of the research show that several types of errors n made by n students at SMP Muhammadiyah 1 Godean in solving fraction comparison problems based on Newman's theory were as follows: 1) Students had difficulty in reading the meaning of n problems given. (2) Students still have difficulty understanding questions, whether it is understanding the concept of fractions or the concept of comparison symbols in fraction material. (3) Students still find it difficult to transform story questions or picture questions into mathematical form. (4) Students have difficulty in the process of solving n problems given, such as finding the least common multiple in the denominator of a fraction. (5) Students find it difficult to conclude the answer to a given problem. According to Newman's theory, researchers can see that reading, understanding, and transforming problems are the mistakes that students most often make.

REFERENCES

- DEAS, H. D. (1960). 'What Is Mathematics?' Higher Education Quarterly, 14(1), 35–41. <https://doi.org/10.1111/j.1468-2273.1960.tb01726.x>
- Haryati, Suyitno, & Junaedi. (2016). Analisis kesalahan siswa smp kelas vii dalam menyelesaikan soal cerita Pemecahan masalah berdasar prosedur newman. *Unnes Journal of Mathematics Education (UJME)*, 5(1), 8–15. <http://journal.unnes.ac.id/sju/index.php/ujme>
- Mahmudah, W. (2018). Analysis of Student Errors in Solving Hots Type Math Problems Based on Newman's Theory. *Jurnal UJMC*, 4(1), 49–56.
- Syahril, R. F., & Kartini, K. (2021). Analisis Kesalahan Siswa Berdasarkan Objek Matematika pada Materi Barisan dan Deret di Kelas XI SMA/MA. *Jurnal Cendekia: Jurnal Pendidikan Matematika*, 5(3), 2816–2825. <https://doi.org/10.31004/cendekia.v5i3.766>