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STUDENTS' PROPORTIONAL REASONING IN MATHEMATICS THROUGH COVID-19 PANDEMIC CONTEXT

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Abstract

The aim of this study was to ascertain junior high school students' proportional reasoning in the sense of the COVID-19 pandemic. How do students' thoughts flow when confronted with problems requiring proportional reasoning? This research is a mixed study by collecting data through problem-solving questions to 253 junior high school students in Muaro Jambi, Jambi Province, Indonesia. The problem-solving activities are based on real-world scenarios and require reasoning that is proportional and pertinent to the COVID-19 pandemic context. Due to the ongoing COVID-19 pandemic, the test is administered through the Whatsapp framework. Students' responses are examined in detail to ascertain their proportional reasoning skills. The results indicate that almost all students correctly answered the first question. However, only a small percentage of students were able to answer to and make the correct argument for the second question. The findings indicated that students demonstrated a reasonable level of proportional reasoning when confronted with the COVID-19 pandemic situation. According to the findings of this report, it is important for teachers of mathematics to establish learning activities and problem-solving tasks that help students improve their proportional reasoning skills.

Keywords: COVID-19; problem solving; proportional reasoning; real-world situations.

Abstrak

Tujuan dari penelitian ini adalah untuk menggali penalaran proporsional siswa SMP dengan konteks pandemi COVID-19. Bagaimana alur pemikiran siswa ketika dihadapkan pada masalah yang membutuhkan penalaran proporsional? Penelitian ini merupakan penelitian campuran dengan pengumpulan data melalui pertanyaan pemecahan masalah kepada 253 siswa SMP di Muaro Jambi, Provinsi Jambi, Indonesia. Kegiatan pemecahan masalah didasarkan pada skenario dunia nyata dan membutuhkan penalaran yang proporsional dan relevan dengan konteks pandemi COVID-19. Karena pandemi COVID-19 yang sedang berlangsung, tes dikirim melalui aplikasi Whatsapp. Tanggapan siswa diperiksa secara rinci untuk memastikan kemampuan penalaran proporsional mereka. Hasilnya menunjukkan bahwa hampir semua siswa menjawab pertanyaan pertama dengan benar. Namun, hanya sebagian kecil siswa yang mampu menjawab dan membuat argumen yang benar untuk pertanyaan kedua. Hasil penelitian menunjukkan bahwa siswa memiliki alur penalaran proporsional yang cukup baik dengan menggunakan konteks kondisi pandemi COVID-19. Menurut temuan ini, penting bagi guru matematika untuk menetapkan kegiatan pembelajaran dan tugas pemecahan masalah yang membantu siswa meningkatkan keterampilan penalaran proporsional mereka.

Kata kunci: *COVID-19; pemecahan masalah; penalaran proporsional; situasi dunia.*

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INTRODUCTION

The critical aspect of mathematics is that it makes sense. Students develop their ability to think logically when studying mathematics. Logic can help students develop their ability to think correctly (Cresswell & Speelman, 2020). Reasoning skill is a critical component of mathematics education. Reasoning is a critical part of mathematical skill when it comes to studying mathematics. According to the (American Psychological Association, 2015), reasoning is the inductive or deductive character's method of drawing conclusions from facts or premises. The rationale is inextricably linked to how one draws conclusions based on both direct and indirect premises. The argument's essence lies in how one arrives at rational conclusions. Reasoning as a cognitive method is essential for problem solving (Kafadar, 2012). (Bronkhorst et al., 2020) define reasoning as the ability to create claims, evaluate them, and draw conclusions.

According to (Hjelte et al., 2020), The reasoning is not domain-specific and may be used to any math assign-ment or course. This area focuses on how students justify their position, solution, or conclusion. Reasoning can be described as the mental process by which established facts are connected to an inference or generalization (Bozkuş & Ayvaz, 2018; Mata-pereira & Ponte, 2017). Additionally, according to (Erdem & Gürbüz, 2015), mathematical reasoning can be described as a high-level thought process that entails deriving meaning from a problem or phenomenon by posing questions in the form of "why" and "how." Mathematical reasoning is a vital skill that students in schools must possess (Tshabalala, 2018). According to (Macbeth, 2012), mathematical logic can be used to illustrate, justify, and prove something.

Proportional reasoning is one form of mathematical reasoning. Proportion is the equality of two ratios, and comparable problems include multiplication relationships that can result in the formation of the same two rates (Ben-Chaim et al., 2012). Proportional reasoning entails the "intentional" use of multiplication relationships to compare amounts and to forecast the value of a quantity based on other values (Brown et al., 2020; Pelen et al., 2016). Proportional reasoning is one of the reasons that mathematics is important to understand. Understanding fractions, percentages, ratios, decimals, scales, and algebra, as well as student opportunities, all require the ability to reason proportionally (Begolli et al., 2021; Brown et al., 2020; Hilton et al., 2016; Hilton & Hilton, 2018; Im & Jitendra, 2020; Jacobson et al., 2018; Johar & Yusniarti, 2018; Ojose, 2015; Orrill & Millett, 2020; Pelen et al., 2016; Sawatzki et al., 2019). Additionally, much of mathematics includes proportional reasoning, including unity, statistics, algebra, opportunities, and social arithmetic. Due to the vast amount of mathematical material that requires proportional reasoning, students who lack a strong foundation in proportional reasoning will have difficulty learning mathematics.

According to (Olson et al., 2015), when two quantities are proportionately linked, the ratio of one to the other is invariant when both numbers' numerical values vary by the same factor. Proportional reasoning's fundamental concepts are ratio and proportion. A critical stage of growth is for students to begin thinking of rates as distinct entities from the two measures that

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comprise them. Ratios and proportions are computed using multiplicative rather than addition comparisons.

As a theme of extensive study, pedagogy mediates real-world contexts (Omuvwie, 2015). (Stillman & Brown, 2019) characterize real-world contexts or circumstances as textual explanations of understandable conditions under which students can contextualize mathematical questions. In well-known international evaluation programs such as the Program for International Student Assessment (PISA), real-world contexts or cases are critical dimensions (OECD, 2013). Finding topics from real-world circumstances or backgrounds in mathematics is extremely fascinating and aids students in comprehending given mathematical problems, making concepts easier to grasp (Kacerja, 2012).

The continuing COVID-19 outbreak provides a great chance to teach proportional thinking principles. The backdrop of the Covid-19 pandemic is one of the most realistic scenarios that students face today. This condition was precipitated by the widespread coverage of the Covid-19 pandemic in the mainstream media. The news reported on the number of individuals infected with Covid-19 and the virus's rate of transmission. However, many individuals continue to be perplexed by the significance of the data provided. (Romano et al., 2020) said that giving information to the public to aid in their comprehension may enhance their reaction to COVID-19. As a result, the mass media and policymakers interacting with the public should constantly depict the pandemic's development using linear graphs and exposure statistics given in ratios and proportions. This condition, of course, is inextricably linked to the proportional thinking skills that the community, and more precisely, should possess and must be comprehended by students. Thus, it can be concluded that using the pandemic context improves students' proportional thinking skills in classrooms. Using the Covid-19 epidemic as an example, teachers must still preserve students' psychological well-being by instilling a feeling of hope that we must continue to live a healthy lifestyle and follow health procedures and that the outbreak will eventually end. According to the clarification above, this research question is how students' thought flows when confronted with a proportional reasoning problem. This study aimed to examine junior high school students' proportional reasoning abilities considering the COVID-19 pandemic.

RESEARCH METHODS

This research is a cross-sectional sample with a single data collection point. As a result, determining the status of current participants and describing their accomplishments, solution methods, challenges, and the reasons for their difficulties with proportional reasoning takes little time. Due to the fact that the study was performed during the Covid-19 pandemic, proportional reasoning test questions were distributed through WhatsApp. Additionally, the answer to the question is returned via WhatsApp. Additionally, an in-depth study of multiple students' responses to problem-solving questions was conducted to corroborate the data gathered via problem-solving questions.

This research included students in the seventh, eighth, and ninth grades of junior high school. The sample size for this study was 253, with as many as 96 seventh-grade students (39.9 percent), 86 eighth-grade students (34 percent),

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and 71 ninth-grade students (28 percent). These students were randomly chosen from five schools in Muaro Jambi, Jambi Province, Indonesia. This sampling technique is the most widely used and dependable method of probability samping from a population (Creswell, 2014). In Sample Random Sampling, samples are randomly drawn from all members of the population without regard for population strata.

These students were given proportional reasoning tests and instructed to complete tasks clearly and fully. Students use the WhatsApp program to submit their responses to the questions. After gathering all student answers, an in-depth examination of selected students' responses repre-senting each class is conducted. Each class selects three student response sheets. Since the responses of each selected student can be used to represent the entire sample, it can be assumed that responses from students other than those selected will not provide additional details.

Two proportional reasoning problems are presented in the sense of the Covid-19 pandemic. They are related to the concepts of ratio, proportion, and reasoning in general. Table 1 summarizes the issues. Prior to presenting the issue to students, the researcher consults with two experts from a mathematics education study program who are interested in mathematical reasoning or proportional reasoning. The two experts were asked to provide feedback on the quality and appropriateness of the questions, as well as the problem's meaning, completeness, and format. After completing the revision based on expert reviews, trials are conducted and the issue is updated based on the results. The two proportional problems are described in detail in Table 1.

Table 1. Proportional reasoning problems context of COVID-19

No.	Problems
1.	Indonesian citizens infected with the COVID-19 virus are shown in the figure below. (Image source from kompas.com, on May 11, 2020).

a. What is the ratio of the number of dead to recovered?
b. What is the ratio of the number of healed to the treated?
c. What is the ratio of the number of treated to all cases?
d. What percentage is the number who died?
e. What proportion is recovered?
f. What is the ratio of the number of cases in West Java to DKI Jakarta?
g. What is the ratio of the number of cases in West Java to East Java?

2.	Based on data on Monday (11/5/2020) at 12.00 WIB, there were 233 new cases of COVID -19 in the last 24 hours. The addition caused a total of 14,265 cases of COVID-

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No.	Problems
	19 in Indonesia, counting from the first case announced on March 2, 2020. If there continues to be an increase in the number of new cases, 233 cases occur each day. a. What is the predicted number of cases on May 20, 2020? b. Compare with the number of real instances that happen in the field (Find information through the official media https://covid19.go.id/). Is there a difference between the prediction of the case that you have calculated in part a). with which the number of real evidence in the field? c. If there is a difference, give your reason why that could happen?

Collecting and Analyzing Data

After collecting the students' responses, an examination of the responses is conducted to focus on the students' mathematical thought, evaluate the relevance, generalizability, and efficiency of the students' mathematical ideas, and identify their conceptual difficulties. The research is focused on students' work on proportional reasoning problems. The aim of this study was to analyze the responses of nine students in order to ascertain their proportional thought and reasoning processes while they worked on previous-ly completed achievement tests. Additionally, additional problems were assigned to students who were interviewed to further analyze their proportional reasoning. Furthermore, additional tasks were given to allow students to hone their proportional reasoning. This issue is taken from the NCTM's study of high school students' proportional thinking. This additional problems are fully illustrated in Figure 1 anda Table 2.

The data of COVID -19 cases scattered in each province in Indonesia as of 21 May 2020.

LAPORAN MEDIA HARIAN COVID19 TANGGAL 21 MEI 2020 PUKUL 12.00 WIB

data dapat berubah sesuai hasil verifikasi

NO	PROVINSI	JUMLAH KASUS TANGGAL 21 MEI 2020			JUMLAH KASUS DENGAN FOLLOWUP SPESIMEN 2X NEGATIF			JUMLAH KASUS MENINGGAL		
		S/D 20 MEI 2020	21 MEI 2020	KUM	S/D 20 MEI 2020	21 MEI 2020	KUM	S/D 20 MEI 2020	21 MEI 2020	KUM
1	ACEH	18	0	**18**	15	0	**15**	1	0	**1**
2	BALI	371	3	**374**	276	4	**280**	4	0	**4**
3	BANTEN	699	54	**753**	162	9	**171**	62	3	**65**
4	BANGKA BELITUNG	35	1	**36**	24	0	**24**	1	0	**1**
5	BENGKULU	67	2	**69**	1	2	**3**	2	0	**2**
6	DI YOGYAKARTA	209	6	**215**	97	8	**105**	8	0	**8**
7	DKI JAKARTA	6236	65	**6301**	1329	129	**1458**	472	9	**481**
8	JAMBI	89	0	**89**	4	0	**4**	0	0	**0**
9	JAWA BARAT	1876	86	**1962**	412	10	**422**	124	0	**124**
10	JAWA TENGAH	1192	25	**1217**	253	2	**255**	70	0	**70**
11	JAWA TIMUR	2496	502	**2998**	387	16	**403**	228	13	**241**
12	KALIMANTAN BARAT	132	1	**133**	32	4	**36**	4	0	**4**
13	KALIMANTAN TIMUR	264	2	**266**	85	11	**96**	3	0	**3**
14	KALIMANTAN TENGAH	241	13	**254**	105	10	**115**	11	0	**11**
15	KALIMANTAN SELATAN	547	10	**557**	76	0	**76**	52	2	**54**
16	KALIMANTAN UTARA	160	2	**162**	51	0	**51**	1	0	**1**
17	KEPULAUAN RIAU	140	0	**140**	83	0	**83**	12	0	**12**
18	NUSA TENGGARA BARAT	393	17	**410**	213	4	**217**	7	0	**7**
19	SUMATERA SELATAN	646	28	**674**	77	1	**78**	19	2	**21**
20	SUMATERA BARAT	428	8	**436**	145	7	**152**	23	0	**23**
21	SULAWESI UTARA	152	28	**180**	31	0	**31**	8	3	**11**
22	SUMATERA UTARA	250	23	**273**	74	0	**74**	30	1	**31**
23	SULAWESI TENGGARA	202	0	**202**	25	0	**25**	5	0	**5**
24	SULAWESI SELATAN	1101	34	**1135**	367	31	**398**	56	3	**59**
25	SULAWESI TENGAH	115	2	**117**	26	11	**37**	4	0	**4**
26	LAMPUNG	85	16	**101**	29	2	**31**	6	0	**6**
27	RIAU	107	1	**108**	63	0	**63**	6	0	**6**
28	MALUKU UTARA	96	1	**97**	12	0	**12**	4	0	**4**
29	MALUKU	124	11	**135**	21	1	**22**	7	0	**7**
30	PAPUA BARAT	106	4	**110**	6	1	**7**	1	0	**1**
31	PAPUA	409	1	**410**	48	0	**48**	6	0	**6**
32	SULAWESI BARAT	78	8	**86**	25	0	**25**	2	0	**2**
33	NUSA TENGGARA TIMUR	76	3	**79**	6	0	**6**	1	0	**1**
34	GORONTALO	28	16	**44**	15	0	**15**	2	0	**2**
	Dalam Proses Verifikasi di Lapanga	21	0	**21**	0	0	**0**	0	0	**0**
	TOTAL	**19189**	**973**	**20162**	**4575**	**263**	**4838**	**1242**	**36**	**1278**

Sumber Data : Kementerian Kesehatan RI

Figure 1. Additional problems with proportional reasoning

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Table 2. The questions from the problem in Figure 1.

Main Question	Sub-Questions
Which province in Indonesia is propor-tional to its popula-tion, which has the highest number of COVID -19 cases?	1. When calculating the population of each province, which three provinces have the highest proportion of cases? What is their number of cases (can be reported per 1000 cases)? Speak your mind. 2. When calculating the population of each province, which three provinces have the lowest proportion of cases? What is their number of cases (can be reported per 1000 cases)? Speak your mind. 3. Discuss provinces that appear to have a low number of cases, but a proportionately high number of cases. Show your thoughts using mathematics. What are the characteristics of this province (region, population density, etc.) to other provinces that have a proportionately similar number of cases with a low total number of cases? 4. Describe provinces that appear to have a high number of cases, but a proportionately low number of cases. Show your thoughts using mathematics. What are the characteristics of this province (region, population density, etc.) to other provinces that have a proportionately similar number of cases with a high total number of cases?

Analyses of Data

We were able to evaluate pupils' proportional reasoning abilities and get a complete and comprehensive knowledge of them by comparing different data. The two data sets include students' work on the first test question and students' responses to the second test question, which were accompanied by field notes. The first step was to verify the answers to the problems assigned to students. The outcomes of students' efforts to solve correct and incorrect problems are then separated.

Additionally, a descriptive study was conducted by showing the data in Table 3 in order to categorize the number of students who correctly answered and those who still answered incorrectly. Finally, students who have given the correct response are asked additional questions to ascertain their approach to solving the issue.

RESULTS AND DISCUSSION

Analysis of Students' Proportional Reasoning from the First Question

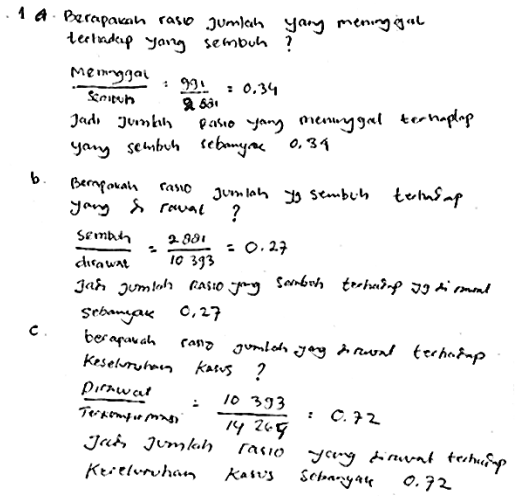

Figure 2. Kimgrace's work

Problem 1 asks about ratio and percent. Problem part 1 (a, b and c) is the concept of the ratio of the number of cases in every province in Indonesia

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affected by COVID-19, recovered, and died. From the answers given by Kimgrace (Figure 2) to problem 1a, it appears that Kimgrace had tried to make a ratio between people who died versus those who recovered, 991: 2881. However, he then went through the process of sharing the data and got a result of 0.34. The same thing was also done for questions number 1 b and 1c, namely the ratio of people recovering compared to those treated, and the proportion of people being treated versus being positively confirmed.

Kimgrace experienced confusion after writing the ratio of questions 1a, 1b, and 1c. Though this is a concept of the ratio which is part of the part, so, Kimgrace should simply make a comparison ratio by simplifying it to a simple form. Like the answer given by Nur Shahnas in Figure 3. Nur Shahnas answers for question 1a by streamlining the ratio to 1: 2.9 then rounding off (rounding is done because this data concerns the number of cases per person). Nur Shahnas made the comparison to 1: 3. The ratio between the number of people who died from COVID-19 compared to the number of people who recovered was 1: 3. Shahnas also used a similar method for questions 1b and 1c.

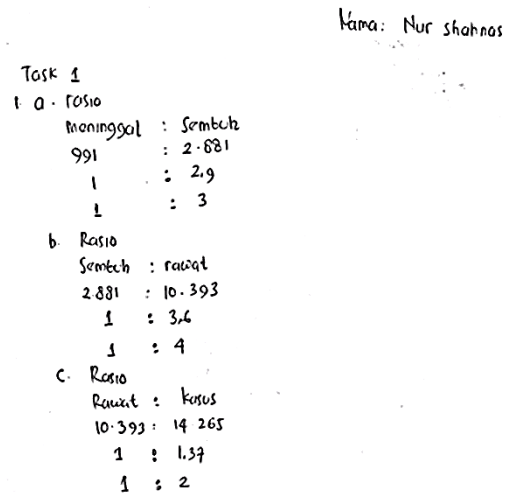

Figure 3. Nur Shahnas's work

Table 3. Student achievement in proportional problems based on the level of difficult

Grade	Answer	Problem 1							Problem 2		
		a	b	c	d	e	f	g	a	b	c
7th grade	Blank	0	0	0	0	2	1	1	4	6	6
	Right	78	77	78	75	75	75	74	74	72	72
	False	18	19	18	21	19	20	21	18	18	18
8th grade	Blank	1	0	0	0	1	1	2	0	3	3
	Right	80	80	81	81	81	81	81	70	72	69
	False	5	6	5	5	4	4	4	16	11	14
9th grade	Blank	0	0	0	0	0	0	0	0	0	0
	Right	70	70	71	71	71	71	71	68	68	67
	False	1	1	0	0	0	0	0	3	3	4
Blank total		1	0	0	0	3	2	3	4	9	9
True total		228	227	230	227	227	227	226	224	212	208
Incorrect total		24	26	23	26	23	24	24	37	32	36

For questions 1d and 1e, Kimgrace was able to do precisely that the percentage of people who died is the number of deaths compared to the number of positive confirmed cases multiplied by 100% (6.94%). Likewise, the percentage of people who recover is the number of cases that are compared with the number of positive confirmed cases multiplied by 100%, which is 20.19%. A similar answer was given by Nur Shahnas and most students who

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were respondents. So, for 1d and 1e, students didn't get many difficulties.

As for questions number 1f and 1g, Kimgrace returned the answer by carrying out the process of sharing the two data cases that were asked. Even though the ratio referred to should be the ratio of parts to parts. The rate of the number of cases in West Java to DKI Jakarta is 1: 9, not the ratio of parts to the whole, which is part of the percent concept. Likewise, the answer to question 1.f is that the ratio of the number of cases in West Java to East Java is 1: 1.

Analysis of Students' Proportional Reasoning from the Second Question

For question number 2, most students can answer the question correctly—for example, the answer to a problem written by Iis (figure 4). IIS was able to answer the prediction of the number of cases on May 20, 2020, which was 16,362 cases. In solving this problem, Iis first predicted cases on May 20 by multiplying the number of additional cases on May 11, which was 233 cases and then multiplying by 9 (number of days from May 11 to May 20, 2020).

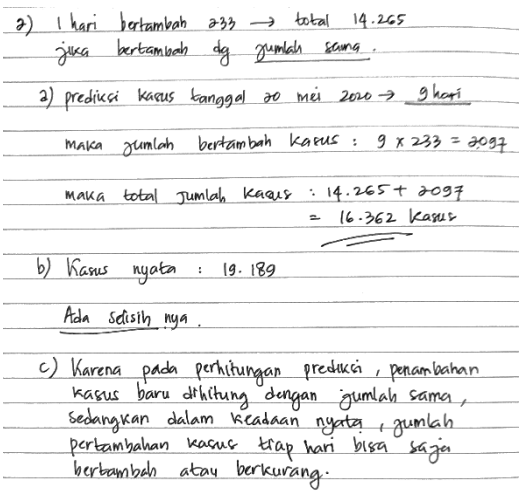

Figure 4. Iis's work

Furthermore, Iis wrote the number of real cases in the field, which was 19,189. Based on these answers, we can observe that Iis can understand the problem well and can answer the question. Iis also stated that there was a difference in the number of real cases by looking for information through the official media https://covid19.go.id/ with a prediction of the number of cases assuming each day the addition remained at 233 cases. However, Iis did not put forward further reasons why the problem could occur.

Haris raised a similar answer. However, Haris also calculated the difference in the number of real cases in the field with the predicted number of cases (figure 5). Haris then stated the reason why there were differences in the prediction of cases with real cases because the number of cases every day was always different and not fixed.

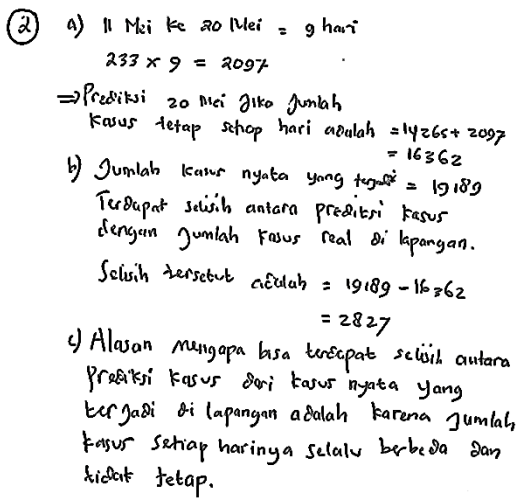

Figure 5. Haris's work

Analysis of Students' Proportional Reasoning from Additional Questions

Based on the answers given by Inaya (Figure 6) for the additional questions given, it can be seen that in answering these further questions, Inaya only considers data on the number of

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positive cases cumulatively. Inaya does not search the total population in each province. For question 3a, Inaya directly determines three provinces with the most cases of COVID-19, namely DKI Jakarta, East Java, and West Java based on data on the additional questions (figure 6). The matter in question is related to the proportion of cases. When viewed from Inaya's answer, Inaya is not accustomed to finding data that is not available in the matter. So it is wrong to answer the question given.

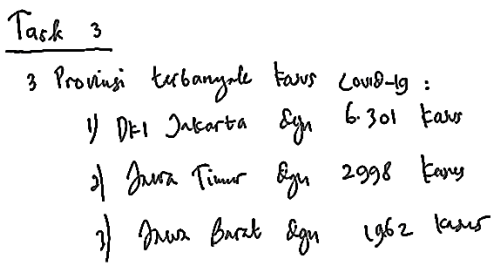

Figure 6. Inaya's work

Nur Shahnas did different things. Nur Shahnas answered this additional problem by first taking into account the population of each Province in Indonesia by utilizing data from the Central Statistics Agency in 2018. Nur Shahnas calculated the highest proportion of cases in the Provinces of DKI, South Kalimantan, and South Sulawesi (Figure 7). Although this answer is still not wrong, Nur Shahnas has tried to find and utilize data on the population of each province. Referring to the population of each province, the highest number of cases of COVID-19 proportionally were East Java (0.076%), DKI Jakarta (0.061%), and North Kalimantan (0.023%). Conversely, the lowest case data are Aceh, Lampung and East Nusa Tenggara, namely 0,00035%, 0.0012% and 0.0014%.

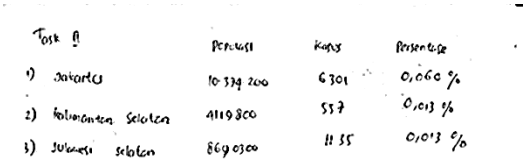

Figure 7. Nur Shahnas's Work

Furthermore, for additional questions in part 3, students are expected to be able to analyze provinces that appear to have a low number of cases, but a proportionately high number of cases. The correct answer is given by Indah (figure 8). Indah stated that North Kalimantan Province had the fewest population in Indonesia based on data from Statistics Indonesia in 2018, which was 691,100. The number of cases of people affected by COVID-19 in North Kalimantan is 162 cases. It means that North Kalimantan appears to have a low number of cases, but it is a proportionately high number of cases. Likewise, for the additional questions in section 4. Indah argues that the province of West Java has the third-highest number of cases in Indonesia based on the data on the problem. Still, proportionally when viewed from the highest population of West Java in Indonesia, amounting to 48,037,600 inhabitants, it can be said cases in West Java are classified as low cases.

Indah argues that several factors make the area considered the most vulnerable to coronavirus transmission. First, regional characteristics such as population density, air quality, and access to adequate housing. Second, the risks are related to the health conditions of the population. Examples are the number of people who smoke, the number of elderly citizens and residents who do not have health insurance. Third, risks are related to population mobility.

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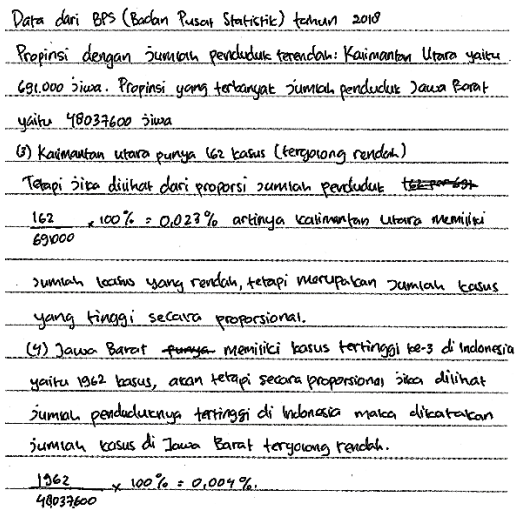
Data dari BPS (Badan Pusat Statistik) tahun 2018
Propinsi dengan jumlah penduduk terendah: Kalimantan Utara yaitu 681.000 jiwa. Propinsi yang terbanyak jumlah penduduk Jawa Barat yaitu 48037600 jiwa
(5) Kalimantan utara punya 162 kasus (tergolong rendah)
Tetapi jika dilihat dari proporsi jumlah penduduk
$\frac{162}{681000} \times 100\% = 0,023\%$ artinya kalimantan utara memiliki jumlah kasus yang rendah, tetapi merupakan jumlah kasus yang tinggi secara proporsional.
(4) Jawa Barat memiliki kasus tertinggi ke-3 di Indonesia yaitu 1962 kasus, akan tetapi secara proporsional jika dilihat jumlah penduduknya tertinggi di Indonesia maka dikatakan jumlah kasus di Jawa Barat tergolong rendah.
$\frac{1962}{48037600} \times 100\% = 0,004\%$.

Figure 8. Indah's work

From the measurements, it appears that West Java is one of the provinces most vulnerable to the coronavirus. It is because the province bears the risk of high population mobility, characteristics of areas with high population density, and poor air quality. Indah gave a more comprehensive answer supported by complete population data and good reason (figure 9). Indah's response and eight other students were then cross-checked through unstructured interviews. Task-based interviews were conducted on nine students to collect more comprehensive data and support the achievement test findings. The findings reveal that almost all students succeed in giving the correct answer to the first problem. Still, for the second problem, only the majority of students can answer and provide the right argument. In addition, more challenging problems are given to students plus interviews, so that it illustrates the difficulties and strategies of students in determining how to solve them.

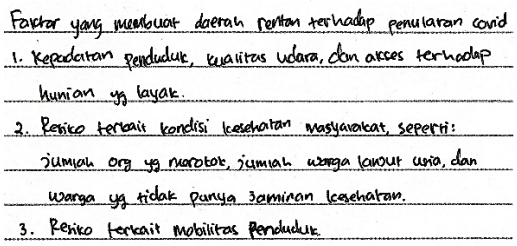
Faktor yang membuat daerah rentan terhadap penularan covid
1. Kepadatan penduduk, kualitas udara, dan akses terhadap hunian yg layak.
2. Resiko terkait kondisi kesehatan masyarakat, seperti: jumlah org yg merokok, jumlah warga lanjut usia, dan warga yg tidak punya jaminan kesehatan.
3. Resiko terkait mobilitas penduduk.

Figure 9. Indah's argumen

Discussion

Proportional thinking is critical to the primary school curriculum's primary objectives and serves as the basis for algebra and its application (Hilton et al., 2016; Sawatzki et al., 2019). Proportional reasoning entails the ability to comprehend multiplication relationships, while the majority of arithmetic concepts depend on the addition principle. According to (Larson, 2013), One of the most critical mathematics abilities for children in the middle grades to acquire is the capacity to think proportionally. Proportional reasoning ability is a strong predictor of students' progress with advanced mathematical reasoning (Lamon, 2012).

Although proportional reasoning is essential for students, students' proportional reasoning has evolved. Some students improve their reasoning skills properly, while others do not. While this is a natural phenomenon, those who are disadvantaged are those with less defined proportional reasoning. Failure to establish proportional reasoning may result in a variety of problems, including inaccuracies in understanding the lessons taught, inaccuracies in understanding the meaning of the problem, and errors in answering questions. Mistakes in comprehending the problem's application will result in incorrect responses, resulting in low grades for students. Thus, it is important to improve students' proportional reasoning abilities in this situation. Via

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reasoning practice questions, students' proportional reasoning ability can increase and they can achieve a higher level of reasoning ability (Bentley & Yates, 2017; Knok, 2017).

Based on the research results obtained, it appears that students have reasonably good proportional reasoning with the context of the problem given concerning the real situation of the COVID-19 pandemic that is currently happening almost all over the world. This study complements Ayan's results that more than half of students, regardless of grade level, can correctly solve most problems (Ayan & Isiksal-Bostan, 2019). This COVID-19 pandemic is a real condition that is truly experienced by nearly all students in Indonesia. It is appropriate that the learning of mathematics and the mathematical problems given relate to real-day examples. Mathematical learning concepts that only tend to be theoretical will make students bored and less motivated to solve questions that are interesting and useful as tools to hone thinking logic. Mathematics must be able to tickle students to explore, find solutions, and continuously want to know to solve problems. The concept of mathematics learning is expected to be able to encourage students to continue to explore new material that is engaged in the field and felt like a new issue nowadays.

Based on students' problems and answers, numbers 1 and 2 related to ratio and proportion. Rates appear in various contexts. Part of proportional reasoning is the ability of students to recognize ratios in multiple situations. For students at the beginning of developing an understanding of ratios and proportions, different contexts or situations seem like different ideas even though they are the same from a mathematical point of view. The teacher must be able to use the context to create problems that will train students' proportional reasoning abilities. When students work on questions number 1 and number 2, students are led by their understanding to be able to answer questions about ratios and proportions. Besides, additional questions adapted from NCTM questions greatly assist students in stimulating their proportional reasoning. Students' proportional reasoning ability will develop if students are given stimulus questions related to ratio and proportion (Lamon, 2012). For number 3, students are also asked to find data in the field related to population in Indonesia and determine which provinces have the highest and lowest number of cases proportionally and provide arguments for why this can occur. There are difficulties and strategies when students try to work on given problems.

The difficulty of students in working on proportional reasoning assignments has led to demands to include proportional reasoning abilities in the curriculum (Dole et al., 2015; Lamon, 2012). Also, research has been conducted to determine how students think in doing proportionality assignments and determine whether developmental or teaching factors are related to proportional reasoning (Dole et al., 2015; Hilton et al., 2016; Hilton & Hilton, 2018). According to (Kusnandi & Rohati, 2020), one of the characteristics of individuals who reason well while studying mathematics is that they constantly establish rules in one circumstance and then apply them to comparable situations.

In the end, we can make students understand proportional reasoning well by utilizing real context in student life. These contexts can help students

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achieve higher proportional reasoning abilities, which in turn can improve other mathematical skills in general. It should be in the context of the Industrial 4.0 era, mathematics teachers to continue to be creative in analyzing and linking the ingredients of learning following the context and elements of life as well as the technological challenges that develop. Teachers must be competent in elaborating teaching material from students' real lives, to create a classroom atmosphere that will form an atmosphere of discovery learning. A must-have a pleasant learning atmosphere because the teacher, as a facilitator, puts students as the center of attention while providing the freedom to find answers to problems independently. The teacher must be able to present new contexts and issues in classroom learning. In the end, the mathematics teacher must be able to involve the experiences or daily situations experienced by students in learning mathematics in class so that the abilities expected to emerge in students can be achieved.

This study has a beneficial effect on teachers, particularly those who teach mathematics in the classroom. Teachers may draw inspiration from the current situation, events, and environment in which their students are studying. Students benefit from proportional thinking not just while studying mathematics, but also when learning other disciplines that need proportional reasoning skills. Thus, it would be ideal if pupils had a high degree of proportional comprehension. Additionally, teachers may continue to enhance the design of learning about proportional reasoning in their classrooms.

CONCLUSION AND SUGGESTION

According to the study findings, students seem to have a fairly excellent flow of proportional reasoning when the context of the issue is the present condition of the COVID-19 pandemic, which is affecting nearly the whole globe. Teachers may create projects in the form of issues that are based on real-world scenarios seen by students. The backdrop of the COVID-19 pandemic enables students to grasp proportional reasoning issues more quickly and engagingly, while also taking into consideration their psychological state during the learning process.

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