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AN EXPLORATION INTO THE ABILITY OF FIFTH-GRADE STUDENTS TO SOLVE DECIMAL PROBLEMS USING PROPORTIONAL REASONING

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Abstract: *Proportional Reasoning is a complex mathematical way of thinking about interconnected ideas such as multiplication and division of whole numbers, fractions, ratios, powers, measurements, and percent. This research aims to identify students' thinking processes in solving decimal problems that require proportional reasoning. This research was conducted on 5th grade elementary school students in Klaten, Central Java, Indonesia, using test instruments, interviews and documentation studies. The test given consists of five types of questions, namely tests on questions that require students to use additive, multiplicative thinking skills, use reasonable or appropriate ratios, build unit structures (groupings), and understand invariants. The research results found that the proportional reasoning indicator that was more dominantly used by students was the ability to think multiplicatively, while the sub-indicators were writing and completing calculations but the final results were not correct. Apart from that, other findings explain that the low ability is due to the prerequisite material not being mastered, students not understanding the questions, and students not understanding the concept of the topic. Thus, these results confirm that proportional reasoning abilities in grade 5 elementary school are still quite low.*

Keywords: *Proportional Reasoning; Elementary school students; Mathematics; Decimal Problem*

INTRODUCTION

Mathematical education at the elementary school level plays an important role in shaping the cognitive foundation of mathematical concepts for students before moving to the next level. One of the important concepts needed to understand mathematics is proportional reasoning (Lundberg, 2022). According to (Lemon (2007) in Mardika & Mahmudi (2021) proportional reasoning is understood as an attempt to detect, reveal, analyze, explain, and provide evidence that supports the statement of proportional relations between two variable sizes. Proportional balancing is also understoody as a complex way of thinking about interrelated ideas such as multiplication and division into integers, fractions, ratios, rank, measurements, and percentages (Jitendra et al., 2021).

Proportional return is traditionally investigated using comparative problems and the problem of lost value (Cramer & Post, 1933) in (Burgos & Godino, 2022). The problem of missing value provides three of the four proportional sizes and the aim is to find the lost value (Lamon, 2007). Example: If you know mixture A juice is made using 2 glasses of concentrated and 3 cups of water, how much concentrate is needed? Mixed into a kettle with five glasses of water? Teaching students to solve problems of lost value risks using excessively proportional reasoning strategies and limiting related critical thinking, because this problem is different from teaching proportionally (Lobato & Ellis, 2010)(Lundberg, 2022).

Comparison problems provide two comparisons (total four sizes) and have the purpose of determining relationships (larger than, less than, or equal to) between ratios. Examples of comparison of proportional reasoning are: It is known that a mixture of juice A is made using 2 glasses of concentrated and 3 cups of water and juice B is made with 1 glass of concentrates and 4 cups, which mixture is more orange-sensitive? Comparative problems provide insight into the various strategies of proportional reasoning that students use and how they argue about quantity and relationships (Lobato & Ellis, 2010).

On the fifth grade of elementary school, students are expected to be able to solve mathematical problems on decimal issues (Kusuma Ardi & Masduki, 2023). A study conducted by Braithwaite et al. (2022) explained that elementary school students showed poor skill in solving fractions and decimals. Students have had difficulty in connecting a decimal to a fraction (Vamvakoussi & Vosniadou, 2010), decimals with larger lengths, for example: 1,4596 vs. 1,4 (Desmet et al., 2010), placing a décimal on a number line and identifying the ratio of the decimal (DeWolf et al., 2015)(Tian et al., 2020).

Nevertheless, understanding fractions and decimals requires an understanding that fraction and decimal have sizes that can be compared, sorted, and placed on a number line (Masduki et al., 2017)(Masduki et al., 2020) (Siegler et al., 2011) in (Braithwaite et al., 2022). Thus, the use of proportional reasoning can help to understand fractions and decimals through the ability indicators that students should have. These proportional indicators consist of additive thinking, multiplicative thinking, the ability to use reasonable or correct ratios, the capacity to build unit structures (grouping), and understanding invariants (Lamon, 1999) in (Lamberg et al., 2005) (Langrall & Safford, 2000) and (McIntosh, 2013) in (Dassa et al., 2022).

The concept of proportional reasoning is applied by presenting real-life situations involving comparisons and fractions in decimal matters. Students should be able to connect mathematical concepts with everyday situations, understand the relationship between decimal numbers, and apply them to solve real-world problems (Lundberg, 2022)(Dassa et al., 2022)(Masduki et al., 2023). Learning the meaning of decimal and fraction involves learning how these numerical symbols can represent several numerical relationships including comparison of parts to whole, ratios, resulting solutions for divisions, and rational numbers (Behr, Lesh, Post & Silver, 1983) in (Binzak & Hubbard, 2020)(Ricart & Estrada, 2022).

Based on research conducted by Avgerinou and Tolmie Tolmie (2020) in Ölmez & Izsák (2020) found that the inhibition control skills of children aged 8 to 10 were positively linked to their ability to compare rational numbers, both fractional and decimal. Although there are fundamental differences with adults, DeWolf et al (2015) in Begolli, Kreshnik N. et al. (2020) argued that generally one prefers a separate and discrete format representing fractions, to evaluate the relationship of the ratio to the fraction and the decimal for problem solving. Therefore, deepening students' proportional reasoning skills in solving decimal issues becomes crucial to understanding how students develop understanding of mathematics in their lives (Lundberg, 2022)(Thanheiser & Melhuish, 2023). This indicates that proportionate reasoning is fundamental for students to understand and develop advanced mathematical topics (Siegler et al., 2010)(Phuong & Loc, 2020)(Begolli, Kreshnik N. et al., 2020)(Thurn et al., 2022).

The main objective of this study is to find out the level of proportional reasoning ability of 5th grade SD students in Klaten district in solving the question of decimals and the factors that influence such abilities. It is based on the study Coulanges et al. (2021) which revealed that the collection of data from the same participants who complete the task of decimal and fractional comparison is necessary to determine whether the skill of fraction and decimal precursor contributes independently to mathematical achievement, or whether both reflect the basic construction of "rational understanding of numbers" and the presence of proportional reasoning that they have. In addition, the research also aims to provide solutions and contributions to the development of a more focused mathematics curriculum in an effort to deduce proportional reasoning of students at the elementary school level.

RESEARCH METHODOLOGY

Research Design

The study uses qualitative methods with phenomenological research designs to explore and interpret the ability of proportional reasoning of elementary school students in solving decimal questions in grade 5 in Klaten district.

Participant

The data was collected at an academically successful elementary school in Klaten district, Indonesia. Students who become research subjects have good academic averages and belong well placed in a particular class. Data collection in the form of a test was carried out against 10 students of 5th grade SD in Klaten district. The students consisted of three female students and seven male students. The participants who took the test were students who had received decimal questions. After all students pass the test, students with the best answers are analyzed and interviewed. The test consists of five questions related to the process of proportional reasoning.

Instrument

Instruments in research related to proportional reasoning capabilities used in this study were synthesized based on indicators found by (McIntosh, 2013) in (Dassa et al., 2022). Table 3.1 below describes the indicators of proportional reasoning used in this study:

Table 1.
Indicators of Proportional Reasoning Ability

Indicators	Description	Score
The ability to think additively	Students can complete aggregate calculations and determine comparisons accurately	2
	Students were able to complete the summary calculation but the end result was inaccurate	1
	Students can't write answers	0
The ability to think multiplicatively	Students can compare two quantities using accurate multiplication	2
	Students are able to compare two quantities using overlapping but the end result is not accurate	1
	Students can't write answers	0
Ability to use a reasonable or fast ratio	Students can compare two quantities with a reasonable comparison accurately	2
	Students are able to compare two quantities with a reasonable comparison but the end result is not accurate	1
	Students can't write answers	0
Ability to build unit structure	Students can group a quantity according to their respective groups correctly	2
	Students are able to group a quantity according to their respective groups but the end result is	1

	inappropriate.	
	Students can't write answers	0
Ability to understand invariant	Students can compare existing quantities and learn that the relationship between the ratio is constant (unchanged) even though the quantity that forms the quarantine ratio (changeable) correctly	2
	Students are able to compare existing quantities and learn that the relationship between the ratio is constant (unchanged) even though the quantity that forms the quarantine ratio (changing) but the end result is not accurate.	1
	Students can't write answers	0

Based on the indicators mentioned above, five questions and proportional reasoning assessment sections measure the performance of students in proportional consideration on decimal questions. The researchers put together a test-related instrument by adapting five questions from previous research (Dassa et al., 2022). Next, the issues that have been prepared are validated by a mathematical education expert. Based on the results of expert validation, the researchers perform improvements to the instrument. Then, the question was tested to 10 students at SDN in Klaten district. Based on the results of the test, the researchers chose 5 questions that will be used for data collection. The researchers used five questions, taking into account the student's completion time of 60 minutes. The five issues of proportional reasoning skills test used include aggregation, multiplication, ratio, grouping and invariant. These issues are described and outlined in the table, as follows:

Table 2.
Proportional Reasoning Test Questions

No	Questions
1	Andes = 1/2 mango and 1.25 wines Tono = 3/4 of the mango and 0.5 of the wine Question: From the fruit that Andi and Tono bought, the amount of fruit Who's heavier?
2	Known: The first book of pictures has a length of 25 cm and a width of 17.6 cm. The second one is 21.0 cm long and 14.8 cm wide. Question: Then count the size of the two sculptures, and compare which one is wider?
3	Known: Budi = 1/2 litre pertalite to fill the motorcycle Bagas = 0.5 litre Pertalite for filling the lawn mower Price 1 liter pertalites Rp. 10,000 The question: then the conclusion is?
4	Known: The gods have two fields of land of 225 square meters. Duwi has two fields of land of 148 square meters. In one of the districts there are several unknown land holders. Land A has a length of 21.5 metres and a width of 10 metres. Land B has a longness of 18.5 meters and a wideness of 8 meters. Land C has 22,5 metres of length and 10 meters of width. Land D has 18.75 meters long and 12 meters wide. Land E has 20 metres long and 10.75 metres wide. Question: The following clusters of land correspond to the size of the land! If the land has an area of 225 square meters means it belongs to the gods, if it has a

	area of 215 square kilometers means of the goddess and if the land is 148 square meter means of Duwi?
5	Known: 2 biscuits require 0.5 kg of wheat and 1⁄4 tablespoon of baking powder Question: How much weight does it take to make eight pancakes?

The Planning, Data collection, Data analysis, and interpretation process

In this phase, the researchers use the data collection with power triangulation techniques. Data collection is done using triangulation techniques with the following stages: (1) performing tests on comparison topics, (2) conducting interviews to deepen, and (3) documentation (Sugiyono, 2012). Data collection at the stage of the interview is done on students who have the highest score and the lowest score to get a deeper meaning of the student's answers. To further explore how students solve problems on decimal issues with proportional reasoning, researchers also documented students' textbooks to study a series of tasks related to decimal questions. This is done to create good credibility in qualitative research (Fraenkel et al., 2012). It is consistent with data analysis (Creswell, 2012), namely: (1) Collecting data from the outcome of the number of students who work problems on decimal issues; (2) Reducing data to focus data that will be used and relevant to research. The data obtained will be analyzed using proportional reasoning indicators. (3) Displays the data, shows the results of the calculation data, thus enabling to produce a conclusion and decision-making. (4). Conclusion: defines the meaning of the data that has been collected and analyzed. At this stage, the results are obtained that can answer research questions.

RESULTS AND DISCUSSION

Results

Generally speaking, questions that contain proportional reasoning are made in five workflows. Students work issues with the workflow on the first issue that contains indicators of proportional rationale with additive thinking abilities. On the second issue contains indicators of multiplicative thinking ability. On the third question contains indicators of ability to use a reasonable or quick ratio. On the fourth item contains an indicator of the ability to build the structure of the unit. The fifth question contains an indicator of the ability to understand invariants. So, in the five tests given, the completion of these decimal questions is done with three indicators in proportional reasoning. Generally speaking, the student's ability to work decimal issues based on proportional indicators of reasoning reviewed from the test that the student has done is shown in Table 3 below:

Table 3.
Total Score Student Proportional Score

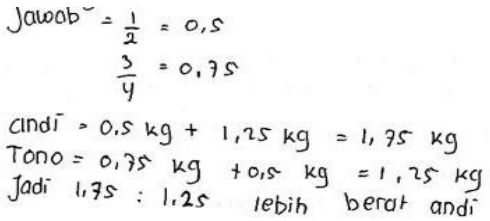
No	Name	Score for each question					Total Score
		1	**2**	**3**	**4**	**5**	
1	S1 (L)	2	2	2	1	2	9
2	S2 (L)	1	2	2	1	1	7
3	S3 (L)	1	1	1	1	1	5
4	S4 (P)	1	1	1	1	1	5
5	S5 (L)	1	1	1	1	1	5
6	S6 (L)	1	1	1	1	1	5
7	S7 (L)	1	1	1	1	1	5
8	S8 (P)	1	1	1	1	1	5
9	S9 (L)	1	1	1	1	1	5
10	S10 (P)	1	1	1	1	1	5
	amount	11	12	12	10	11	

The results of the above test showed that students S1 obtained the highest score with a total score of 9 points. In the second position occupied by students S2 obtaining a score of 7 points. in the third place occupied S3, S4, S5, S6, S7, S8, S9, and S10 obtain the score of 5 points. Further, to strengthen the evidence of the test results above presented documentation of students' answers and analysis of answers of two subjects of students with high abilities (S1 and S2) and two Subjects with low ability (S9 and S10) based on the test score.

Additive Thinking Ability

Based on the analysis of student answers, the abilities of two subjects with high abilities vary in comparing two quantities with the sum. S1 students can demonstrate the sum calculation and determine the comparison accurately, as shown in Figure 1.

Figure 1.
S1 student's answer



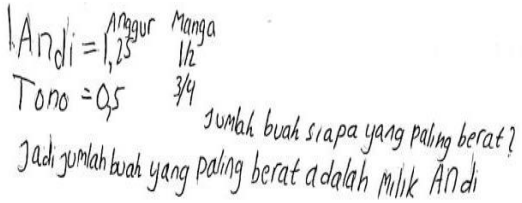
Below is the outcome of an interview that corroborates the response of the S1 student regarding Figure 1 and its relation to additive thinking in Question 1.

Table 4.
S1 student's answer of interviews

Researcher	"How did you finish, mirza?"
S1	"Because of the number asked, then on the number one I counted you. Fruits belong to me, and Tono belongs to me."
Researcher	"How do you add the decimal number?"
S1	"With the way you put it together, and then I'll cut it into a coma that's just as fresh as it is."
Researcher	"Good, then what after you count?"
S1	"Then I compare, ma'am, the total amount of Andi's and Tono's which is heavier."

Based on the answers and interviews with S1 students on question number one, they showed that students can write decimal summing accurately, can compare two quantities correctly and can draw conclusions. Instead, S2 students can't show summing calculations and determine comparisons correctly. as shown in Figure 2.

Figure 2.
S2 student's answer



Below is the outcome of an interview that corroborates the response of the S2 student regarding Figure 2 and its relation to additive thinking in Question 1:

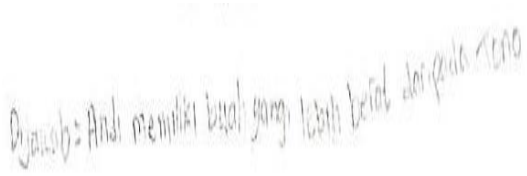
Table 4.
S2 student's answer of interviews

Researcher	"What makes Harits confused?"
S2	"I'm a little confused about turning a fragment into a coma or decimal, ma'am"
Researcher	"Okay, then why can Harits answer that the number of fruits of Andi is

	heavier than that of Tono?"
S2	"Because I'm just counting on you, maybe if there's more of Andi's fruit than Tono's."
Researcher	"If to sum the decimal numbers, is Harits having trouble?"
S2	"No, ma'am, I was more confused when I was told to change the fraction to decimal"
Researcher	"Okay, besides, can Harits understand number one?"
S2	"You know, ma'am, you should use your assembly."
Researcher	"Okay, so Harits' difficulty is turning fractions into decimals, right?"
S2	"Yes, ma'am."

Based on the answers and the results of interviews with students S2 could not correctly write the answer to question 1 to complete the calculation of the summary. Further, in the students who obtained the lowest score were taken two students, namely students S9 and S10, could not show the aggregate calculation and determine the comparison accurately. However, due to the similarity of scores on question 1 between students S10 and S9, then in the figure 3 related to the answer and the result of the interviews the students are represented by the students S10

Figure 3.
S10 student's answer



The following are the results of an interview that corroborate the responses of the S10 student regarding additive thinking in Question 1, as depicted in Figure 3:

Table 5.
S10 student's answer of interviews

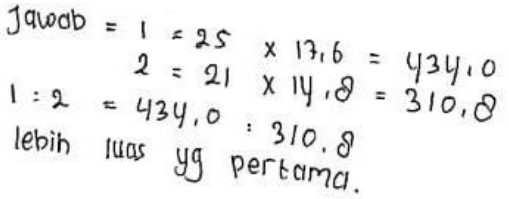
Researcher	"For question number one, can Friska work on the decimal I'm giving you?"
S10	I can't, ma'am.
Researcher	"What's the reason Friska can't answer number one?"
S10	"I don't know, ma'am, how to count the decimal number and the fraction"

Based on the answers and the results of the interviews, S10 students were unable to write decimal summary answers correctly in completing the summary calculation.

The ability to think multiplicatively

Based on the student's answer analysis, the abilities of two high skilled subjects have the same in comparing two quantities with overlapping. Thus, the S1 student represents the student who has acquired a high skill on question number 2.

Figure 4.
S1 student's answer



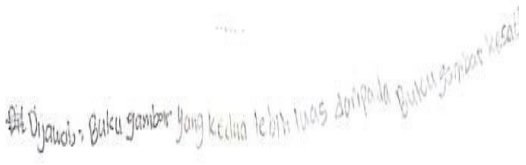
Below is the outcome of an interview that corroborates the response of the S1 student regarding Figure 4 and its relation to multiplicative thinking in Question 2.

Table 6.
S1 student's answer of interviews

Researcher	"How did you finish, mirza?"
S1	"Because on the matter of known long and wide then the way to work it I multiply mom"
Researcher	"Why can you think if there is length and width to be multiplied?"
S1	"Because the drawing book is square in length, so I'm thinking of looking for its breadth."
Researcher	"Good, then after you repeat, is there any further step?"
S1	"The same is true of number one, ma'am, and then I compare it to see which one is wider between book 1 and book 2."

Based on the answers and interviews with S1 students on question number two, they showed that students can compare two quantities using multiplication and can draw an accurate conclusion. Furthermore, in the students who obtained the lowest score took two students, namely students S9 and S10, could not show the calculation of overlap and determine the comparison accurately. However, due to the similarity of scores on question number two between S9 and S10 students, on figure 5 the lowest answer and student interview results are represented by S10 pupils.

Figure 5.
S10 student's answer



Below is the outcome of an interview that corroborates the response of the S10 student regarding Figure 5 and its relation to multiplicative thinking in Question 2:

Table 7.
S10 student's answer of interviews

Researcher	"Can you solve issue number two?"
S10	"No, ma'am"
Researcher	"Did you find any trouble with number two?"
S10	"Yes, I understand the meaning of the question of determining which picture book is wider but I don't know how to finish it."
Researcher	"Where did you get the answers that you wrote on the answer sheet?"
S10	"That's just my estimate, ma'am"

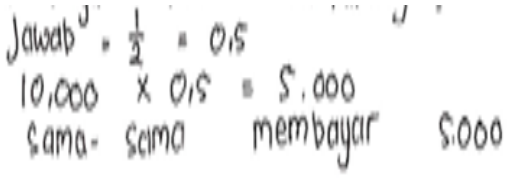
Based on the answers and the results of the interviews, S10 students were unable to write and compare two quantities correctly in the use of multiplication.

Ability to Use Ratio

Based on the student's answer analysis, the abilities of two high skilled subjects have the same in comparing two quantities with the ratio. Thus, the S1 student represents the student who acquired a high skill on question number 3. The S1 students can demonstrate ratio calculation and determine the comparison accurately, as shown in Figure 6.

Figure 6.

S1 student's answer



Below is the outcome of an interview that corroborates the response of the S10 student regarding Figure 7 and the concept of thinking ratio in Question 3:

Table 8.
S1 student's answer of interviews

Researcher	"How did you finish, mirza?"
S1	"When it comes to half and 0.5 bu, it means that it's the same size, both mean half while the price of 1 liter is Rs. 10,000.00 and you pay it for the same price. Budi and Bagas, that is, pay half of the ten thousand, get five thousand."

Based on the answers and the results of interviews with S1 students on question number three showed that students can compare two quantities using ratios and can draw an accurate conclusion. Furthermore, in the students who obtained the lowest score took two students, namely students S9 and S10, could not show the calculation ratio and determine the comparison accurately. However, due to the similarity of scores on question number 3 between S9 and S10 students, the lowest score on figure 7 in relation to answers and interview results is represented by the S10 student.

Figure 7.
S10 student's answer

The following is an interview result that validates the S10 student's response to Figure 7 regarding the thinking ratio in Question 3:

Table 9.
S10 student's answer of interviews

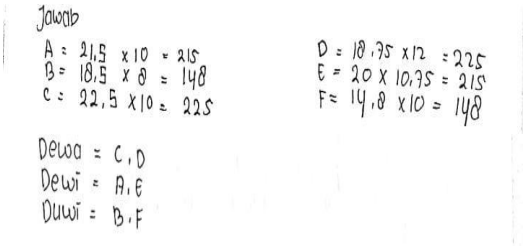
Researcher	"Can you work on number three?"
S10	"No, ma'am, I don't understand about number three at all."

Based on the answers and the results of the interviews, S10 students were unable to write and compare two quantities correctly using the ratio.

Ability to Build Unit Structure (Group)

Based on student answers analysis, the abilities of two subjects with high abilities (S1 and S2) and low (S9 and S10) have a similarity in comparing two quantities by building the unit structure (group). Thus, S1 students represent students who have acquired high and low abilities on the issue number 4. S1 pupils cannot demonstrate calculations in building the unity structure (Group) and determine the comparison accurately, as shown in Figure 8.

Figure 8.
S1 student's answer



The following are the findings of an interview that corroborate the responses of the S1 student regarding their thoughts on constructing the unit's structure in Figure 8, as stated in Question 4:

Table 10.
S1 student's answer of interviews

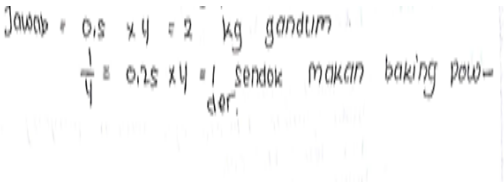
Researcher	"How did you finish, mirza?"
S1	"The same way as no. 2 ma'am, I multiply"
Researcher	"Why did you repeat?"
S1	"Because I've been asked about the size too, ma'am, so I'm thinking about multiplying it."
Researcher	"Then after you have repeated it, what will be the next step?"
S1	"I match the size of the land belonging to three people who have been known to you"
Researcher	"Did you find any trouble with number four?"
S1	"There is, ma'am, it just takes a long time to count it and not very careful in grouping it"

Based on the answers and the results of the interviews, S1 students were unable to write and group a quantity based on their respective groups.

The ability to understand invariants

Based on the student's answer analysis, the ability of two highly skilled subjects varies in comparing two quantities by understanding the invariant. S1 students can demonstrate calculation in understanding invariants and determining comparisons accurately, as shown in Figure 9.

Figure 9.
S1 student's answer



Below is the outcome of an interview that corroborates the response of the S1 student on Figure 9 and their proficiency in understand invariants in Question 5:

Table 11.
S1 student's answer of interviews

Researcher	"Okay, so how do you finish it mas mirza?"
S1	"The way it works I multiply it, but for its fraction I also fox into the shape of a coma bu. Then 8 is mine for 2 ma'am get 4, I only multiply by 0.5 and 0.25 ma'am"
Researcher	"Why are eight yours for two? Didn't they ask what it takes to make eight cakes?"
S1	"Because it's about the known ingredient to make two cakes, not one. That's why I'm giving you two."

Researcher	"Did you find the trick to turn a fraction into a decimal?"
S1	"No, ma'am"
Researcher	"How did you change it?"
S1	"I gave it to the ma'am, so the dealer shared the name of the ma"
Researcher	"Okay, so did you find a problem with number five?"
S1	"No, ma'am."
Researcher	"Thank you, mas mirza, for being able to answer the questions of ma'am ambar.
S1	"Together, ma'am, yeah ma'am"

Based on the answers and the results of interviews with S1 students on question number 5 showed that students can compare existing quantities and learn that the relationship between the ratio is constant (unchanged) even though the quantities that form the quarantine ratio (changeable) correctly. On the contrary, S2 students are unable to compare existing quantities and learn that the relationship between the ratio is constant (unchanged) even though the quantity that forms the (changing) covariant ratio correctly. as shown in Figure 10.

Figure 9.
S2 student's answer

The following are the results of an interview that corroborate the S2 student's responses to Figure 10 regarding their proficiency in comprehending invariants in Question 5:

Table 12.
S10 student's answer of interviews

Researcher	"For issue number five, can harits work on the decimal that ma ambar gives you?"
S2	I can't, ma'am.
Researcher	"What difficulty does Harit encounter with number five?"
S2	"I can't understand the matter and the way it works, ma'am.
Researcher	"Waah, means we have to practice more and more, yes, so that we can work and remain enthusiastic to learn"
S2	"Yes, ma'am."

Based on the answers and the results of interviews with S2 students, they were unable to write the answer to number 5 correctly in comparing existing quantities and knowing that the relationship between the ratio is constant (unchanged) despite the quantity that forms the quarantine ratio. Furthermore, in the students who obtained the lowest score took two students, namely students S9 and S10, could not show invariant calculations and determine the comparison accurately. However, due to the similarity of scores on question number 5 between students S10 and S9, then in the figure 11 that relates to the answers and the result of the interview students represented by the students S10.

Figure 9.
S10 student's answer

Below is the outcome of an interview that corroborates the response of the S10 student about their understanding of invariants in Question 5, as depicted in Figure 11:

Table 13.
S10 student's answer of interviews

Researcher	"Can you work on number five?"
S10	"No, ma'am"
Researcher	"What difficulties have you encountered with the number five?"
S10	"As with the rest of you, ma'am, I don't understand you with her"

Based on the answers and the results of the interviews, S10 students were able to compare existing quantities and find out that the relationship between the ratio is constant (unchanged) even though the quantity that forms the quarantine ratio (changing) but the final result is not accurate.

Discussion

Students show that some students are more dominant in the indicator of proportional reasoning on the ability to think multiplicatively and the ratio in working on decimal issues with a total of 12 points. Whereas, on the indicators of proportionate reasoning about additive thinking and ability to understand invariant in working decimal questions earned the total of 11 points. Next, the indicator of proportional reasoning on the ability to build the unit structure (grouping) in working on the issue of decimal occupies the last order with the sum of 10 points.

Based on the indicators of proportional reasoning, on the ability to think multiplicative and ratio more possessed by students than the ability of additive thinking (comparing two quantities with aggregation), ability to build the structure of units (groups), and ability to understand invariants. This was reinforced by Coulanges et al. (2021) who stated that the ability to compare two quantities using multiplication on decimal questions was easier than comparison on other mathematical arguments. In contrast, the ratio is expressed in the notation of fractions although it does not have the same meaning; unlike the fraction, it is used to express the comparison of the parts; and a ratio can be reinterpreted meaningfully as a fraction or the result of the multiplication or division (Jitendra et al., 2021). Thus, the key component of proportional reasoning is the ability to consider quantities relatively and understand quantity variations and invariance ratios (Lamon, 2007)(Jitendra et al., 2021). When students think ratio then indirectly they also do the process of thinking multiplier (Siegler et al., 2010). Thus, the ability to override has an interrelated relationship with the ability of the student ratio. It is in line with a study conducted by Binzak & Hubbard (2020) revealing that solving a decimal question using proportional reasoning has the intensity of numerical relationships including partial-total comparisons, ratios, solutions resulting from multiplication.

In other studies, students had considerable difficulties in understanding proportional reasoning because they tended to apply additive thinking processes compared to overlapping processes or ratios (Karplus, Pulos & Stage, 1983) in (Norton, 2005). Strengthened by Alfauziyya & Masduki (2023) in his findings stated that there are still many students who are unable to use proportional reasoning on overlap in solving problems. However, based on research carried out by Pramudiani et al., (2022) results in the finding that additive thinking process is a difficult thing for Indonesian students because it often causes misinterpretation in solving the problem of fraction on decimal issues. Besides, they tend to add the decimal part as if it were the sum of the original number. For example, they assume a cumulative result of 0.19 + 0.2 is 0.21, or a reduction of 1.788 - 0.8 is 1.780 (González-Forte et al., 2022). The results of the study are consistent with the findings of this study, which revealed that 10 students tested with 5 decimal questions using proportional reasoning on indicators of additive thinking ability, ability to understand invariants, and ability to construct unit (group) structures were at the lowest among other proportional rationale indicators.

Limitation and Recommendation

The improvement in proportional reasoning of students can be done by practicing them from an early age through repetitive mathematical workmanship (Masduki et al. (2019). Strengthened by research by Begolli, Kreshnik N. et al. (2020) and Begolli, Kreshnik Nasi et al. (2021) explain that example-based practice is beneficial for students who have prior knowledge of proportional reasoning as a key concept to develop their mathematical knowledge. However, the emergence of student misconceptions related to imbalances in making proportional reasoning on each indicator has made it difficult for them to solve decimal issues. Strengthened by Pramudiani et

al. (2022) stated that some student misunderstandings arose because of their unusual way of solving matters in mathematics by using the missing part to represent the other part as a whole. When there is no missing part, students do not find it too difficult to determine the answers in the mathematical question as part of the whole. However, when there is one missing section, different answers appear for different reasons. In addition, students have difficulty in proportional reasoning when calculable information is available because they rely too much on numerical information even when such information causes errors (Hurst et al., 2022). Specifically, some of the factors that can cause such errors are pre-conditional materials that are not mastered, students do not understand the subject, and students don't understand the concept of the subject (Humaira Salsabila et al., 2021)(Fauziyah, 2023). Thus, teachers should ensure that the prerequisites in student proportional reasoning are met and create classroom learning that facilitates students' understanding of mathematical concepts in support of their ability to reason proportionally in answering decimal questions.

CONCLUSION

Conclusion

Based on the research findings and discussions, it can be concluded that: first, PKn learning through culturally responsive teaching can improve the learning outcomes of Grade IV students at One of the elementary schools in Lampung. The evidence of improved student learning outcomes in the PKn learning process after using this teaching method was measured through cognitive tests as an evaluation of the learning process. Based on the research findings, it can be concluded that there was an increase in the average student learning outcomes that met the Minimum Completion Criteria (KKTP) by 70. The pre-cycle average was 52.38, showing an increase of 9.89 to 62.27 in Cycle I and a further increase in Cycle II by 18.86 to 81.13. Second, PKn learning through culturally responsive teaching can increase the cultural interest of Grade IV students at One of the elementary schools in Lampung. The evidence of increased cultural interest among students in the PKn learning process after using this teaching method was measured through student activity tests conducted in each cycle. Based on the research findings, it can be concluded that there was an increase in the percentage. The pre-cycle percentage was 12.50%, showing an increase of 46.59% to 59.09% in Cycle I and a further increase in Cycle II by 31.81% to 90.90%. Based on the results of the above research, it can be concluded that culturally responsive teaching in PKn Learning using Piil Pesenggiri can enhance the cultural interest and learning outcomes of students. For future research, we recommend developing a learning medium that explores the potential of Piil Pesenggiri in the educational environment.

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