Proportional Reasoning Level Based on Student Self-Efficacy Review

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Abstract. This study attempts to analyze the level of students' proportional reasoning in terms of self-efficacy by classifying students' self-efficacy, describing the levels of students' mathematical proportional reasoning, and describing the differences of their levels in terms of self-efficacy. The subjects of this study were students of class VII with a total of 40 students who had received proportion matter. The research instruments are questionnaires, test questions, interviews, observations, and documentation. The data collection procedure begins with students filling out a self-efficacy questionnaire. After the results of the questionnaire were obtained, two students were selected for each category, then reasoning tests and interviews were conducted. The results showed that from 40 students, three self-efficacy classifications were obtained, namely, nine students with high enough self-efficacy, 28 students with moderate self-efficacy, and three students with moderately low self-efficacy. Based on the results of this data analysis, it was found that students' proportional reasoning was at level 0 and level 3. At level 0, students could not solve proportional problems. They can only solve unknown values by using addition, difference, or unpatterned calculation, i.e., using arbitrary numbers and operations. At level 3, students can do proportional reasoning using unit values or scale factors in solving unknown value problems. Then there are differences in the level of mathematical proportional reasoning between students who have high enough self-efficacy, moderate self-efficacy, and moderately low self-efficacy.

Keywords: Mathematical Proportional Reasoning Level; Proportion Matter; Self-efficacy

1 Introduction

The reasoning is an important activity for students in the mathematics learning process, so that students can understand the concept and apply the concept in mathematical problems [1]. Because the reasoning process and mathematics have a close relationship, the lack of application of reasoning in learning activities can cause students to have difficulty solving problems [2]. Therefore, the reasoning is very important which is needed in learning mathematics.

Based on the results of The Trends in International Mathematics and Science Study (TIMSS) 2011, the level of mathematical reasoning of Indonesian students is very low when compared to the international average score. Indonesia is below the average and is far from other neighboring countries [3]. Based on the results of the 2015 TIMSS that Indonesian students are ranked 44th out of 49 countries in their reasoning ability [4]. Mathematical reasoning of Indonesian students based on the results of PISA as much as 75.7% of Indonesian students mathematical reasoning has not reached level 2 and as many as 42.3% of Indonesian

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students mathematical reasoning has not reached level 1, where level 1 is the lowest level in the reasoning process [5]. Based on the results of TIMSS and PISA it can be stated that the mathematical proportional reasoning of Indonesian students is still relatively low even though the reasoning process is very important in learning mathematics.

Proportional reasoning is important for students to solve comparative problems, understand, apply, and develop them. Proportional reasoning is the basis for students to solve fractions problems and understand mathematical concepts such as fractions, decimals, ratios, and proportions [6]–[8]. It can be concluded that proportional reasoning is a thinking process related to mathematical problems to achieve an understanding of concepts from comparative material such as ratios and proportions.

Improving mathematical proportional reasoning can be done by using appropriate learning strategies, to design learning strategies can be done by knowing the students' mathematical proportional reasoning process [9], [10]. Therefore, teachers must know the level of students' proportional reasoning in order to improve students' mathematical proportional reasoning.

Self-efficacy is the belief that a person has about his ability to solve problems so that he can overcome various situations that arise in his life [11], [12]. It can be concluded that self-efficacy is the belief attached to each individual to take any action based on his ability. Students' mathematical reasoning is not influenced by self-efficacy but can be influenced by other factors, so there is no relationship between self-efficacy and increased students' mathematical reasoning [1], [13]. There is a strong relationship between self-efficacy and students' mathematical reasoning, the higher the student's self-efficacy, the higher the mathematical reasoning [14]. Based on some of the statements above, there are differences of opinion regarding the relationship between mathematical reasoning and self-efficacy. Therefore, the researcher conducted research on the analysis of the level of students' mathematical proportional reasoning in terms of self-efficacy.

Several researchers have conducted studies on mathematical reasoning and self-efficacy. Most of them discuss the description of the level of students' proportional reasoning, classification of self-efficacy, and differences in the level of students' mathematical proportional reasoning, by considering the problem, research subject, and subject matter [15]–[17]. Another study discusses increasing mathematical reasoning ability by using a bridging analogy approach in terms of self-efficacy [1]. However, in this study focuses on describing the level of students' proportional reasoning based on self-efficacy. The purpose of this study is to classify students' self-efficacy, describe the level of mathematical proportional reasoning, and describe the different levels of students' mathematical proportional reasoning based on self-efficacy. This research is very important to improve the mathematical proportional reasoning of students who are classified as low. Teachers need to use the right strategy during the learning process by knowing the level of students' proportional reasoning. After that, the teacher can design the right strategy to be used during the learning process in the classroom.

2 Research Method

This study uses a descriptive qualitative design. Qualitative descriptive research is one of the research methods carried out in natural conditions and emphasizes the process rather than the product [18]. Then called qualitative because the data collected and the analysis is more qualitative. The data obtained is more precise, more in-depth, credible, and meaningful with

qualitative, so that the research objectives can be achieved. This research was conducted in class VII SMP-IT Nurul Huda Foundation for the 2020/2021 academic year.

Participants in this study were students of class VII SMP-IT Nurul Huda Foundation a total of 40 participants in the early stages of data collection to classify students' self-efficacy. After that, the two participants with the highest scores in each category of self-efficacy were selected for further analysis regarding their level of mathematical proportional reasoning. The determination of participants in this study was done using the purposive sampling technique. The purposive sampling technique is collecting data from participants to consider several aspects. The aspects considered are 1) participants are students of grade VII Junior High School, and 2) participants have studied proportion material so that participants are expected to be able to master the material that has been studied previously.

The data collection technique is a way for researchers to obtain information in the form of data obtained from participants. Data collection can be done in several ways. In this study, data were obtained from the participants of the SMP-IT Nurul Huda Foundation. The research source is the seventh-grade students of SMP-IT Nurul Huda as many as 40 participants. The data collection techniques that will be used by researchers are questionnaires, proportional reasoning tests, interviews, and observations. The research procedures carried out are as follows

1) Formulating the problem under study, namely classifying self-efficacy, describing the level of students' mathematical proportional reasoning in terms of self-efficacy, and describing the different levels of students' mathematical proportional reasoning in terms of self-efficacy.
2) Determining research participants
3) Develop research instruments, in the form of self-efficacy questionnaires, proportional reasoning test questions, interviews, and observations.
4) Validate research instruments. All instruments used have been validated and declared valid by the validator (expert).
5) Conducting direct field research begins by providing a self-efficacy questionnaire instrument. After that, give proportional reasoning test questions and finally conduct an interview.

3 Result and Discussion

Based on the results of observations in the field, some students have a low level of proportional reasoning (level 0) and there are differences in the results of previous studies. Therefore, the researcher researched the level of students' mathematical proportional reasoning in terms of self-efficacy.

3.1. Classifying Student Self-efficacy

To find out the classification of student self-efficacy owned by research participants, the researchers used a questionnaire that had been validated by 4 validators. The test consists of 26 questions in the form of statements in 13 positive statements and 13 negative statements. Each statement contains indicators of self-efficacy (each question has a different order of indicators). There are five answers (always, often, sometimes, rarely, and never) where students have to choose one answer by putting a checkmark on the option that suits them. Each answer they choose has its points according to the self-efficacy questionnaire scoring

guidelines. The self-efficacy scoring guidelines *are* presented in table 1 and the self-efficacy category guidelines *are* presented in table 2 as follows.

Table 1. Self-efficacy Questionnaire Scoring Guidelines

No	Answer Options	Scoring Scale	
		Positive Statement	**Negative Statement**
1	SL (Always)	5	1
2	SR (often)	4	2
3	KD (Sometimes)	3	3
4	JR (Rare)	2	4
5	TP (Never)	1	5

Source: Adapted from [1]

Table 2. Self-efficacy Category Guidelines

No	Value Interval	Category Self-efficacy
1	91-100	Very high
2	78-90	High
3	65-77	High enough
4	52-64	Moderate
5	39-51	Low enough
6	26-38	Low
7	14-25	Very low

Source: Adapted from [19]

The following are the results of the self-efficacy classification of class VIII students of SMP-IT Nurul Huda.

Table 3. Results of Student Self-efficacy Classification

Category of Self-efficacy	Number of Students	Percentage (%)
Very high	0	0
High	0	0
High enough	9	22.5
Moderate	28	70
Low enough	3	7.5
Low	0	0
Very low	0	0

Based on Table 3, there are three categories of self-efficacy in student class VII i.e. self-efficacy is high enough, self-efficacy is moderate, and self-efficacy is low enough. *The* self-efficacy of the dominant students is in the moderate self-efficacy category with a percentage of 70% while for the high enough category it only gets a percentage of 22.5% and the self-efficacy category is low enough with a percentage of 7.5%. Someone with high enough self-efficacy has great confidence when faced with every problem and they will try hard to overcome the existing problems [20]. Meanwhile, someone with low self-efficacy considers himself/herself to not have the ability to solve existing problems. When they are faced with a difficult situation, they will tend to give up easily and feel they can't do anything to solve the problem.

3.2. Description of Students' Mathematical Proportional Reasoning Level

The researcher chose six participants with the provision that two participants each had the highest score from each category to test the mathematical proportional reasoning questions. The selected participants are presented in table 4 as follows.

Table 4. Selected Participants Test of Proportional Reasoning Questions

No	Participants	Score		Amount	Average	Self-efficacy Test
		Positive Statement	Negative Statement			
1	SP	60	40	100	76.92	High enough
2	ND	54	45	99	76.15	High enough
3	NS	46	37	83	63.85	Moderate
4	ANA	42	40	82	63.08	Moderate
5	NF	31	35	66	50.77	Low Enough
6	NR	35	30	65	50	Low Enough

To find out the level of students' mathematical proportional reasoning with proportion material, the researchers gave test questions. The form of the test questions given are in the form of description questions that have been prepared and adapted to proportional reasoning indicators modified from [2]. The test questions were then validated by four validators. The indicators for mathematical proportional reasoning are presented in table 5 and the level guidelines for mathematical proportional reasoning are in table 6 as follows.

Table 5. Indicators of Mathematical Proportional Reasoning

No.	Indicator	Description
1.	Ability to calculate worth comparisons using the right strategy	Students can solve the problem of comparative material worth using the correct strategy
2.	The ability to calculate the value-turned-comparison with the right strategy	Students can solve the problem of material comparison of reversed values by using the correct strategy
3.	Ability to calculate comparisons with three problems	Students can solve comparative material problems with three problems using the correct strategy

Table 6. Guidelines for Mathematical Proportional Reasoning Level

No.	Proportional Reasoning Level	Description of Student Work Results
1	Level 0 (non-proportionate)	Students who are at this level have not been able to solve proportional problems, they are only able to solve unknown values by using addition or difference. The solutions they use are not patterned.
2	Level 1 (manipulative proportional reasoning)	Students who are at this level can do proportional reasoning using pictures, models or manipulation of the problems to be solved.
3	Level 2 (replicative proportional reasoning)	Students at this level can perform proportional reasoning using repeated addition or constructing both measures in solving unknown value problems.
4	Level 3 (pre-multiplicative proportional reasoning)	Students at this level can do proportional reasoning using unit values or scale

No.	Proportional Reasoning Level	Description of Student Work Results
		factors in solving unknown value problems.
5	Level 4 (multiplicative proportional reasoning)	Students at this level can perform proportional reasoning using cross multiplication or equivalent fractions in solving unknown values.

Source: Adapted from [21]

The following is a description of the results of the research on the level of mathematical proportional reasoning of students with fairly high self-efficacy.

Table 7. Level of Student Self-efficacy Proportional Reasoning is High Enough

Indicators of Student's Mathematical Proportional Reasoning	Information	
	SP participant	**ND participants**
Ability to calculate worth comparisons using the right strategy	Unable to calculate worth comparisons using the correct strategy. SP is at level 0 (non-proportional reasoning)	Able to calculate the comparison of worth using the correct strategy, namely the variable factor strategy. SP is at level 3 (pre-multiplicative reasoning)
Ability to calculate value-reverse comparisons using the right strategy	Unable to calculate the rate-return ratio using the correct strategy. SP is at level 0 (non-proportional reasoning)	Unable to calculate the rate-return ratio using the correct strategy. ND is at level 0 (non-proportional reasoning)
Ability to calculate comparisons with three problems	Unable to calculate comparisons with three problems. SP is at level 0 (non-proportional reasoning)	Unable to calculate comparisons with three problems. ND is at level 0 (non-proportional reasoning)

Based on table 7, SP and ND have quite high self-efficacy but both have different levels of proportional reasoning. In question 1, the indicator of the ability to calculate comparisons worth SP is at level 0 (non-proportional reasoning) while ND is at level 3 (pre-multiplicative proportional reasoning). In question 2 with an indicator of the ability to calculate inverse comparisons, the SP and ND values are at level 0 (non-proportional reasoning) and question 3 with an indicator of the ability to calculate comparisons with the three problems both are also at level 0 (non-proportional reasoning). According to [21] someone who is at level 0 means they have not been able to solve proportional problems, they solve these problems using arbitrary operations and those at level 3 mean they can solve proportional problems using scale factors or unit values. In line with [13] states that students' mathematical reasoning abilities are not influenced by self-efficacy but can be influenced by other factors.

SP and ND have quite high self-efficacy, one of which is shown during interviews, both are participants who are able to answer questions well and can be seen from their style which is full of calm and confidence. This is in line with Bandura's statement (in [13]), a person who has high enough self-efficacy will create a calm feeling in the face of a difficult activity or problem. When working on proportional reasoning problems, both of them are very enthusiastic and have full confidence in their abilities. In line with [20] states that someone

with high enough self-efficacy has great confidence when faced with every problem and they will try hard to overcome the existing problems.

SP tends to have skills that are less visible from the answers that SP give during the interview process and are not very able to explain precisely according to the questions asked by the researcher while ND has better skills than SP. ND has good skills, this can be seen from the answers he gave in accordance with the questions the researchers asked. Regarding these skills, [11] states that self-efficacy is not related to the skills a person has, but is related to individual beliefs about what can be done with the skills he has, no matter how big.

The following is a description of the results of the research on the level of mathematical proportional reasoning of students with moderate self-efficacy.

Table 8. Moderate Self-efficacy Students' Proportional Reasoning Level

Indicators of Student's Mathematical Proportional Reasoning	**Information**	
	NS participants	**ANA participants**
Ability to calculate worth comparisons using the right strategy	Able to calculate the comparison of worth using the correct strategy, namely the variable factor strategy. NS is at level 3 (pre-multiplicative proportional reasoning)	Unable to calculate worth comparisons. ANA is at level 0 (non-proportional reasoning)
Ability to calculate value-reverse comparisons using the right strategy	Unable to calculate the rate-return ratio using the correct strategy. NS is at level 0 (non-proportional reasoning)	Unable to calculate the rate-return ratio using the correct strategy. ANA is at level 0 (non-proportional reasoning)
Ability to calculate comparisons with three problems	Able to calculate comparisons with three problems using unit values. NS is at level 3 (pre-multiplicative proportional reasoning)	Unable to calculate comparisons with three problems. ANA is at level 0 (non-proportional reasoning)

Based on table 8, it can be seen that NS and ANA have moderate self-efficacy but both have different levels of proportional reasoning. In question 1, the indicator of the ability to calculate comparisons worth NS is at level 3 (pre-multiplicative proportional reasoning) while the ANA is at level 0 (non-proportional reasoning). In question 2 with an indicator of the ability to calculate inverse comparisons, the NS and ANA values are at level 0 (non-proportional reasoning) and question 3 with an indicator of the ability to calculate comparisons with three NS problems is at level 3 (pre-multiplicative proportional reasoning) while the ANA is at level 0 (reasoning). non-proportionate). According to [21] someone who is at level 0 means they have not been able to solve proportional problems, they solve these problems using arbitrary operations and those at level 3 mean they can solve proportional problems using scale factors or unit values.

Based on the results of the self-efficacy questionnaire, NS and ANA are participants who have moderate self-efficacy. According to [11] states that self-efficacy can change meaning that it can be learned through four main sources of information, namely *mastery experience, vicarious experience, verbal persuasion, and physiological state*. ANA tends to have skills that are less visible from the answers ANA gave during the interview process and are not very able to explain precisely according to the questions asked by the researcher while NS have better skills than ANA. NS has good skills; this can be seen from the answers he gave in

accordance with the questions asked by the researcher. Regarding these skills, [11] states that self-efficacy is not related to the skills a person has, but is related to individual beliefs about what can be done with the skills he has, no matter how big. The following is a description of the results of the research on the level of mathematical proportional reasoning of students with low self-efficacy.

Table 9. Level of Student Self-efficacy Proportional Reasoning is Low Enough

Indicators of Student's Mathematical Proportional Reasoning	**Information**	
	NF participants	**NR participants**
Ability to calculate worth comparisons using the right strategy	Unable to calculate worth comparisons. NF is at level 0 (non-proportional reasoning)	Able to calculate worth comparisons using the correct strategy, namely the variable factor strategy. NR is at level 3 (pre-multiplicative proportional reasoning)
Ability to calculate value-reverse comparisons using the right strategy	Unable to calculate the rate-return ratio using the correct strategy. NF is at level 0 (non-proportional reasoning)	Unable to calculate the rate-return ratio using the correct strategy. NR is at level 0 (non-proportional reasoning)
Ability to calculate comparisons with three problems	Unable to calculate comparisons with three problems. NF is at level 0 (non-proportional reasoning)	Able to calculate comparisons with three problems using unit values. NR is at level 3 (pre-multiplicative proportional reasoning)

Based on table 9, it can be seen that NF and NR have fairly low self-efficacy but both have different levels of proportional reasoning. In question 1, the indicator of the ability to calculate comparisons worth NR is at level 3 (pre-multiplicative proportional reasoning) while NF is at level 0 (non-proportional reasoning). In question 2 with an indicator of the ability to calculate inverse comparisons, the NF and NR values are at level 0 (non-proportional reasoning) and question 3 with an indicator of the ability to calculate comparisons with three NR problems is at level 3 (pre-multiplicative proportional reasoning) while NF is at level 0 (reasoning non-proportionate). According to [21] someone who is at level 0 means they have not been able to solve proportional problems, they solve these problems using arbitrary operations and those at level 3 mean they can solve proportional problems using scale factors or unit values.

NF and NR have fairly low self-efficacy, one of which is shown during interviews, both of them are participants who answer the researcher's questions with uncertainty and doubt about their ability to solve proportional reasoning questions. This is in line with Bandura's statement (in [13]) that a person who has low self-efficacy will be easily discouraged, unsure of his abilities when solving a problem, tends to be stressed, and has a narrow vision. In line with the statement [20] states that a person with low self-efficacy considers himself or herself to not have the ability to solve existing problems. When they are faced with a difficult situation, they will tend to give up easily and feel they cannot do anything to solve the problem.

3.4. Differences in Students' Mathematical Proportional Reasoning Levels Based on Self-Efficacy

From the results of the description of the data analysis, each level of self-efficacy has a different level of proportional reasoning. Even in this study, although they have the same level

of self-efficacy, they have different levels of reasoning. The different levels of students' mathematical proportional reasoning are presented in table 10 as follows.

Table 10. Differences in Students' Mathematical Proportional Reasoning Levels

No	Participants	Self-Efficacy Test	Proportional Reasoning Level		
			Problem 1	Problem 2	Problem 3
1	SP	High enough	Level 0	Level 0	Level 0
2	ND	High enough	Level 3	Level 0	Level 0
3	NS	Moderate	Level 3	Level 0	Level 3
4	ANA	Moderate	Level 0	Level 0	Level 0
5	NF	Low Enough	Level 0	Level 0	Level 0
6	NR	Low Enough	Level 3	Level 0	Level 3

Based on table 10 in question 1 (the ability to calculate equivalent comparisons using the correct strategy) it can be seen that SP, ANA and NF are at level 0 (non-proportional reasoning). According to [21] suggests that students who are at level 0 have not been able to solve proportional problems, they are only able to solve unknown values by using addition, difference or unpatterned counts, namely using any numbers and operations. While ND, NS, and NR are at level 3 (pre-multiplicative proportional reasoning). According to [21] suggests that students who are at level 3 can do proportional reasoning using unit values or scale factors in solving problems of unknown values. According to [13] states that students' mathematical reasoning is not influenced by self-efficacy but can be influenced by other factors. This statement is in accordance with the difference in the level of mathematical reasoning in participants with different self-efficacy categories, for example, SP (self-efficacy is high enough) in question 1 is at level 0 while NR (self-efficacy *is* low enough) in question 1 is at level 3.

In question 2 (the ability to calculate inverse comparisons using the correct strategy) it can be seen that all participants are at level 0 (non-proportional reasoning). According to [21] states that students who are at level 0 have not been able to solve proportional problems, they are only able to solve unknown values by using addition, difference or non-patterned counts, namely using any numbers and operations. In accordance with Van de Walle's statement (in [15]) which states that one of the students' mistakes in solving comparison problems is including unknown values. In this case, students do not fully understand the relationship between two quantities. It can be concluded that the six participants with indicators of the ability to calculate inverse comparisons of values, all selected participants have not been able to understand the relationship between two quantities, meaning that participants have not been able to use reasoning problem solving strategies correctly. To overcome the problem at the level of mathematical proportional reasoning where all selected participants are dominantly at level 0 especially in question 2, [22] states that the level of students' mathematical proportional reasoning can be increased by using the application of the Connecting, Extending, and Review (CER) learning model which has been effective to use.

In question 3 (ability to calculate a comparison with the three problems) it is known that SP, ND, ANA, and NF at the level of 0 (reasoning nonproportional). According to[21] states that students are at level 0 cannot solve the problem of proportion. NS and NR are at level 3 (pre-multiplicative proportional reasoning). According to[21] states that the student is at level 3 can perform proportional reasoning by using the value of the unit or the scale factor in solving the problem of unknown value. It can be seen students with self-efficacy is high enough as participants SP and ND at about 3 at the level of 0 and ANA with self-efficacy was

at the level of 0 as well. Meanwhile, NS (self-efficacy moderate) and NR (self-efficacy is low enough) at about 3 in the level 3. The condition according to [11] states that self-efficacy is not related to one's own skills, but related the individual's beliefs about things to do with the skill he possessed no matter how big. In line [1] states that there is no relationship between self-efficacy with an increase in students' mathematical reasoning. Classification of mathematical reasoning students with self-efficacy of different will remain the same despite being given the treatment is different because of self-efficacy in accordance with students' beliefs rather than the reasoning ability.

4 Conclusion and Suggestion

Based on the results of this research is that the classification of self-efficacy of students is dominated by self-efficacy with category with details of 9 self-efficacy is high enough, 28 self-efficacy moderate, and 3 self-efficacy is low enough. Students with a fairly high self-efficacy category are at level 0 meaning they have not been able to solve proportional problems in question 2 (the ability to calculate the comparison of turning values using the correct strategy) and question 3 (the ability to calculate comparisons with three problems). In question 1 (the ability to calculate worth comparisons using the correct strategy) students with a fairly high self-efficacy category are at level 0 and level 3.

Students with the self-efficacy category are at level 0 meaning that they have not been able to solve the proportional problem in question 2 (the ability to calculate the comparison of turning values using the correct strategy). In question 1 (the ability to calculate comparisons worth using the correct strategy) and question 3 (the ability to calculate comparisons with three problems) students in the self-efficacy category are at level 0 and level 3.

Students with a fairly low self-efficacy category are at level 0 meaning they have not been able to solve the proportional problem in question 2 (the ability to calculate the comparison of turning values using the correct strategy). In question 1 (the ability to calculate the ratio worth using the correct strategy) and question 3 (ability to calculate a comparison with three issues) students with the category of self-efficacy is low enough to be at level 0 and level 3. From the description of the data analysis, each category of self-efficacy has different levels of mathematical proportional reasoning, although with the same self-efficacy category.

From the results of the study, it can be seen that each category of self-efficacy has a different level of proportional reasoning even with the same self-efficacy category having a different level of reasoning. Students are more dominant at level 0 which means they have not been able to solve proportional problems. By knowing the level of students' proportional reasoning, the teacher can apply the CER learning model which is effectively used to increase the level of students' mathematical proportional reasoning. The CER learning model consists of three elements, namely (1) *connecting*, students learn by connecting their knowledge with concepts in the material studied in groups, (2) *extending*, students can develop their abilities by doing various similar questions, and (3) *review*, students re-check the results of the work on the questions that have been done. In addition, teachers can design appropriate learning strategies such as *inquiry* learning strategies that emphasize critical and analytical thinking processes so that students are required to find their own answers to a given problem or problem-based strategies that emphasize the completion process to solve a problem. By applying the CER approach and appropriate learning strategies, teachers can help students increase the level of students' mathematical proportional reasoning. For further research, it is

recommended to conduct research on the development of learning strategies that can increase the level of students' mathematical proportional reasoning.

References

[1] N. Agustiana, N. Supriadi, and K. Komarudin, "Meningkatkan Kemampuan Penalaran Matematis dengan Penerapan Pendekatan Bridging Analogy Ditinjau dari Self-Efficacy," *Inov. Pembang. J. Kelitbangan*, vol. 7, no. 1, p. 61, 2019.

[2] L. Khoiriah and D. R. Munandar, "Analisis Kemampuan Penalaran Proposional Pada Siswa Smp Dalam Menyelesaikan Materi Perbandingan," *Pros. Sesiomadika*, vol. 2, no. 1b, 2020.

[3] R. Rosnawati, "Kemampuan penalaran matematika siswa SMP Indonesia pada TIMSS 2011," in *Prosiding Seminar Nasional Penelitian, Pendidikan dan Penerapan MIPA, Fakultas MIPA, Universitas Negeri Yogyakarta*, 2013, vol. 18, pp. 1–6.

[4] Nizam, "Ringkasan Hasil-hasil Asesmen: Belajar Dari Hasil UN, PISA, TIMSS, INAP," 2016.

[5] OECD, "Overview: Excellence and Equity in Education," *PISA 2015 Results (Volume I): Excellence and Equity in Education*. OECD Publishing Paris, 2016.

[6] S. Dole, "Ratio tables to promote proportional reasoning in the primary classroom," *Aust. Prim. Math. Classr.*, vol. 13, no. 2, pp. 18–22, 2008.

[7] W. K. Nabors, "From fractions to proportional reasoning: a cognitive schemes of operation approach," *J. Math. Behav.*, vol. 22, no. 2, pp. 133–179, 2003.

[8] S. Im and A. K. Jitendra, "Analysis of proportional reasoning and misconceptions among students with mathematical learning disabilities," *J. Math. Behav.*, vol. 57, p. 100753, 2020, doi: https://doi.org/10.1016/j.jmathb.2019.100753.

[9] C. Febriani and A. H. Rosyidi, "Identifikasi penalaran induktif siswa dalam memecahkan masalah matematika," *J. Mathedenusa*, vol. 2, no. 1, 2013.

[10] A. Bakker, D. Groenveld, M. Wijers, S. F. Akkerman, and K. P. E. Gravemeijer, "Proportional reasoning in the laboratory: An intervention study in vocational education," *Educ. Stud. Math.*, vol. 86, no. 2, pp. 211–221, 2014.

[11] A. Bandura, W. H. Freeman, and R. Lightsey, "Self-efficacy: The exercise of control." Springer, 1999.

[12] M. N. Ghufron and R. Risnawita S, "Teori-teori Psikologi," 2010.

[13] N. Himmi, "Korelasi self-efficacy terhadap kemampuan penalaran matematis mahasiswa semester pendek mata kuliah trigonometri UNRIKA TA 2016/2017," *PYTHAGORAS J. Math. Educ. Study Progr.*, vol. 6, no. 2, 2017.

[14] A. Aprisal and S. Arifin, "Kemampuan Penalaran Matematika dan Self-Efficacy Siswa SMP," *Delta J. Ilm. Pendidik. Mat.*, vol. 8, no. 1, pp. 31–40, 2020.

[15] A. Prayitno, A. Rossa, and F. D. Widayanti, "Level penalaran proporsional siswa dalam memecahkan missing value problem," *J. Ris. Pendidik. Mat.*, vol. 6, no. 2, pp. 177–187, 2019.

[16] Y. Nugraha, I. Sujadi, and P. Pangadi, "Penalaran proporsional siswa kelas VII," *Beta J. Tadris Mat.*, vol. 9, no. 1, pp. 34–47, 2016.

[17] R. Eka, "Penalaran Proporsional Siswa Kelas VII SMP Negeri II Beji Pasuruan Berdasarkan Tingkat Kemampuan Matematika," *MATHEdunesa*, vol. 2, no. 1, 2013.

[18] S. Sugiyono, "Memahami Penelitian Kualitatif, Cet," *Ke-12. Bandung Alf.*, 2016.

[19] A. I. Sadewi, D. Y. P. Sugiharto, and E. Nusantoro, "Meningkatkan self efficacy pelajaran matematika melalui layanan penguasaan konten teknik modeling simbolik," *Indones. J. Guid. Couns. Theory Appl.*, vol. 1, no. 2, 2012.

[20] R. E. Riggio, *Introduction to industrial/organizational psychology*. Routledge, 2017.

[21] A. Prayitno, A. Rossa, F. D. Widayanti, S. Rahayuningsih, and M. Baidawi, "Characteristics of

students' proportional reasoning in solving missing value problem," in *Journal of Physics: Conference Series*, 2018, vol. 1114, no. 1, p. 12021.

[22] A. M. I. T. Asfar and A. Aspikal, "Pengembangan Model Pembelajaran Berbasis Connecting Extending Review (CER) untuk Meningkatkan Kemampuan Penalaran Matematika," in *Seminar Nasional Riset Inovatif*, 2017, vol. 5, pp. 621–630.