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Proporsional Reasoning Matematics Student 4th Grade on *Learning Cycle 5e* Nuanced Ethnomatematics

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Abstract

The purpose of this study is to find the stages of students' mathematical proportional reasoning in learning cycle 5e nuanced ethnomathematics. The type of research used is mixed methods with concurrent embedded design. The population of this research is the students of SD IT Bunayya 2019/2020 Academic Year. The research subjects were students in grade IV, amounting to 20 children. Data collection techniques in the form of tests, interviews and documentation. The results showed that students' mathematical proportional reasoning in learning with learning cycle 5e nuanced ethnomathematics was grouped into three namely, students in the recognition of multiplicative relationships group, students in accommodating covariance and invariance groups, and students in functional and scalar relationships groups. In this study, students found obstacles in mathematical proportional reasoning that students have not been able to recognize additive and multiplicative relationships in understanding the similarity of ratios, recognizing rational plausibility, and have not been able to do unitizing. To address this, students need to be trained and understood about the concept of fractions worth and discuss about ratios that make sense.

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INTRODUCTION

The National Research Council (1989) states mathematics is the foundation of science and technology and mathematics is the key to the advancement of knowledge and technology. The same thing was also stated by Darmawijaya (2002) that mathematics was able to provide opportunities to be utilized in the study and development of other sciences, especially basic science and technology. Along with the times, the development of students' mathematical abilities are increasingly required to increase. One way to improve is to develop student reasoning and proportional reasoning is the reasoning needed when studying mathematics (Ratna, 2013).

Proportional reasoning is the cornerstone for success in the higher and higher levels of mathematics (capstone) of elementary school mathematics, besides that proportional reasoning is a principle that encompasses all aspects of mathematics and the center of mathematical subdiscipline (Purnomo, 2015). Proportional reasoning is related to students' sensitivity to situations involving proportional relationships. Cai and Sun (2002) state that proportional reasoning is related to sensitivity to covariation, multiple comparisons, and the ability to remember and process several parts of information. Psychologically, proportional reasoning is a way of thinking that involves sensitivity to quantitative relationships and comparing ratios.

It was found that the mathematical proportional reasoning ability of students at SD IT Bunayya Semarang was still lacking. It is shown that there are still many students experiencing difficulties in measuring and changing units. Though this material is very basic that must be mastered because as a prerequisite material for the next material. Besides that, from all students, only 50% had completed KKM. When this material has not been completed, surely student achievement will be hampered.

On the material measurement and changing units will involve mathematical proportional reasoning. The comparison activity is very important to develop the concept of measurement, and to change one unit to another there is a ratio or proportion to change it. Thus students must reason proportionately.

According to Geary (Schunk, 2012), the constructivist learning theory assumes that humans are active students who develop knowledge for themselves. Of the various learning models that are able to involve students to develop their knowledge, one of them is the learning model of learning cycle 5e. The use of the learning cycle 5e model can improve the ability of reasoning and is effective against students' mathematical reasoning (Noviantari, 2015; Pitriati, 2019). So that learning cycle 5e becomes one of the solutions or alternatives to improve student reasoning.

According to Trianto (2008), learning cycle 5e is a student-centered learning model and emphasizes the importance of the process of students discovering important concepts through student involvement in the learning process. Learning cycle 5e consists of 5 stages: engage, explore, explain, elaborate, evaluate. The stages of the learning cycle 5e can arouse students' curiosity and make students actively build their own knowledge by interacting with the environment (Anwar M., 2013). In line with Sudargo (2016) mathematics basically grows from skills or culture in the community, so that one's mathematics is influenced by the cultural background in the environment. According to Bishop, mathematics that grows in a society is called ethnomathematics.

The link between the 5Ee learning cycle and ethnomathematics when combined will produce interesting learning. Student enthusiasm is expected to increase with the activities or activities that involve students. The basis of this approach is the relationship of teachers with students' cultural values and culture related to the curriculum (Sudargo, 2016). The role of a teacher in using this model becomes very important so students will feel close to what is called mathematics, and comfortable learning mathematics. Students' mathematical proportional reasoning is expected to increase.

Based on the background, this research is focused on the study of the stages of students' mathematical proportional reasoning in the learning cycle 5e nuanced ethnomathematics.

METHODS

This research is part of a mixed methods concurrent embedded research method with qualitative research as the primary method. The population is the fourth grade students of SD IT Bunayya Semarang in the even semester of the 2019/2020 school year. Sampling uses a cluster random sampling technique, which is randomly selected two classes from the population, namely class IV A as the experimental class and class IV B as the control class.

This research consists of two stages, namely the pre-field stage and field work. In the pre-field stage the researchers prepared research equipment including syllabus, lesson plans, ethnomatematics modules, interview guidelines, and Mathematical Proportional Reasoning Test (TPPM). All research equipment was consulted with a supervisor and specifically for TPPM first tested.

At the stage of the field work begins by giving TPPM pretests to the experimental and control classes. Furthermore, the researchers conducted four lessons with rounding material measuring the length and weight using the learning model of learning cycle 5e nuanced ethnomathematics. In the end, the TPPM posttest student learning is given to the experimental and control class. The subjects in this study were all students in the experimental class of twenty students.

RESULT AND DISCUSSION

The Effectiveness of Learning Cycle 5E Model with Ethnomathematics Nuances

The results of the final test analysis (TPPM) obtained that the final data of the experimental class and the control class were normally distributed and had homogeneous variance. Based on the testing that has been done it can be seen (1) using the proportion test, obtained $z_{table} = 1.64 < z_{count} = 2.103$ and this can mean the percentage of students who completed individually in learning cycle 5e nuanced with ethnomatics over or equal to 75%. So the mathematical proportional reasoning of students who obtain learning cycle 5e nuanced ethnomatematics reaches mastery learning, (2) using the average difference test, obtained $t_{count} = 3.814 > t_{((0.95)(39))} = 1.68$, so it can concluded that the average mathematical proportional reasoning of students in class with learning cycle 5e nuanced ethnomatematics is higher than students' mathematical proportional reasoning in classes with conventional learning. It is also known from the results of TPPM that the average value of experimental class students was 76.10 and control class students was 69.67, (3) using paired average difference test, the value of $t_{count} = 2.337 > t_{((0.95)(19)} = 1.729$ so that it can be concluded that the average mathematical proportional reasoning of students in the class after being given learning cycle 5e nuanced ethnomatematics more than the average mathematical proportional reasoning of students in the class before being given learning cycle 5e nuanced ethno-mathematical learning.

Based on these studies indicate that learning with a learning cycle 5e nuanced ethnomathematics shows effective for increasing students' mathematical proportional reasoning. This is in line with Noviantari (2015) and Pitriati (2019) learning cycle 5e becomes one of the solutions or alternatives to improve student reasoning, more specifically students' mathematical proportional reasoning.

Mathematical Proportional Reasoning Students

The students' mathematical proportional reasoning data in the learning cycle 5e nuanced ethnomathematics were obtained from the results of the TPPM posttest questions and would be compared with the results of the interviews. Based on TPPM post test data analyzed. based on the five stages used by students in solving mathematical proportional reasoning problems according to Bexter and Junker (Weaver and Junker, 2004), namely (1) qualitative (2) early attempts at quantifying (3) recognition of multiplicative relationships (4) accommodating covariance and invariance (5) functional and scalar relation-ship. From the analysis results obtained are then grouped based on the similarity of achieving mathematical proportional reasoning stages. After grouping the data, it is described how the mathematical proportional reasoning of the subjects in this study. Based on the data analysis of mathematical proportional reasoning stages, students are grouped into 3 groups: (1) subject groups with stages of recognition of multiplicative relationships; (2) groups of subjects with accommodating covariance and invariance stages; and (3) groups of subjects with functional and scalar relation-ship stages. For more details can be seen in table 1.

Table 1. Step of mathematical proportional reasoning students

No	Grup	Subject	Mathematical Proportional Reasoning Stage Indicators
1	*recognition of multivikative relationships*	S1, S3, S5, S7, S10, S13, S14, S20	Students have the intuition that the ratio is two numbers that change together but the student still thinks that the change may be caused by summation or multiplications. Students more often use the summation strategy when faced with multiplication situations.
2	*accommodating covarian-ce and invariance*	S2, S4, S6, S8, S9, S12, S15, S16, S17, S18, S19	Students begin to develop a completion model if some quantity changes, but the relationship of those quantities remains. Students look for unit factors and scalar multiplication approaches to build the model he develops. Students can find the unit values of existing measurements and use them in resolving the overall problem. When students fail to develop a completion model, students return to how to determine the difference in addition.
3	*fanctional and scalar relation-ship*.	S4, S11	Students understand a fixed relationship between the changing quantity. Students have a general model to solve problems and choose an efficient strategy to use. Students understand the structure of the relationships present in each measurement

Subjects at the stage of recognition of multiplicative relationships in solving students' problems have the intuition that the ratio is two numbers that change together but students still think that the change might be caused by addition or multiplication. Students more often use a summing strategy when faced with multiplication problems, when faced with division students solve with the concept of dividing fairly on fractions. Students use a calculation that continues to decrease or continue to increase besides the subject states that they prefer to use the addition relationship rather than multiplicative.

This is in line with Cayton Hodges, et al (2012) stating that students at this level have intuition about the existence of multiplicative relationships but when students fail to look for multiplicative relationships then students will return to the sum strategy. According to Langral and Swafford (2000), the strategies used by students in this group belong to the level of qualitative reasoning where students use images, models, or other manipulations to understand the situation and use comparisons qualitatively.

Subjects at the accommodating covariance and invariance stage begin to develop a settlement model that is if some quantities change, but the relationship of those quantities remains. In addition, the subject also sought a unit factor and a scalar multiplication approach to build the model he developed. In this case lnmon (2012) calls it Unitizing, where in the process students determine the unit of measure given in quantity. The model that has been developed is then used to find other quantities

This is in line with Cayton-Hodges, et al (2012) at the accommodating covariant and invariance stages students have begun to develop scalar factors. According to Langral and Swafford (2000) Students in this group enter the stage of quantitative reasoning without manipulation or can relate a problem to a numerical calculation model such as multiplication and division

Subjects at the Functional and scalar relationships stage begin to understand that there is a constant relationship between changing quantities. Students begin to have a general model for solving problems and choosing more efficient strategies. Even writing the formula used then substitutes the known value according to the formula written. The steps undertaken look simpler or shorter compared to students in the previous group.

This is in line with Cayton-Hodges, et al (2012) in the functional and scalar relationships stage of students having a general model for solving problems and choosing efficient strategies to use. According to Langral and Swafford (2000) this group enters the formal proportional reasoning stage where students can set comparisons using variables using cross multiplication or fractions of value.

Barriers to Mathematical Proportional Reasoning Students

Based on research data obtained from the results of student work and interview results can be summarized data on the obstacles experienced by students in solving mathematical proportional reasoning questions of students in three groups such as the pliers listed in table 2 as follows.

Table 2. Barriers to mathematical proportional reasoning students

No	Barriers	Subject	Descriptions
1	Barriers I	S1, S3, S5, S7, S20	Students can’t yet recognize the difference between additive and multiplicative relationships
2	Barriers II	S3, S5, S7	Students have not been able to recognize the situation using a reasonable ratio
3	Barriers III	S1, S20	Students have not been able to do unitizing

Based on the table above there are three groups based on the obstacles of the research subjects. Subjects not listed in the table above indicate that students do not find obstacles in working on mathematical proportional reasoning problems.

Subjects in this group are still working on the problem by involving additive relations or addition relationships even though faced with multiplicative problems. Then there are those who do it using repetitive subtraction or repeated addition. This is shown in one of the students 'work in solving students' mathematical proportional reasoning questions.

Besides still using the addition relationship in this group students still do not really understand the additive and multiplicative relationships in understanding the similarity of ratios. When students are given two pairs of ratios, they are then asked to determine which pair of ratios is equivalent. Students in this group assume that the ratio is the same or equivalent as seen from the difference in the ratio numbers.

This is in line with Purnomo (2015), when offered several pairs of ratios and asking students to choose which ratios are equivalent, sometimes, students have a pattern of thinking that the equivalent ratios are the difference between the same ratio numbers.

The obstacle in group II is that students have not been able to recognize situations where the use of rational is reasonable or appropriate. When asked questions related to ratios, subjects were still wrong in determining the ratio. This shows that the subject actually does not understand a reasonable ratio. When students are wrong in determining this ratio, the answers to be obtained will be wrong too. This is in line with the opinion of Purnomo (2015) when students are given statements about the ratio then students are asked the question whether the statement makes sense or not sometimes students are still confused. So this will inhibit students' mathematical proportional reasoning.

Barriers to mathematical proportional reasoning of students in group III namely students do not have the ability to do unitizing. Unitizing is a mental and natural process used to determine units of a given quantity of measure. Barriers that students experience is because from the beginning students have been wrong in determining the ratio or relationship between quantities. In determining the unit of measure the quantity will be wrong. This is in line with Purnomo (2015), that when the unitizing ability is not yet mastered by students, students will experience difficulties in solving mathematical proportional reasoning questions.

To overcome the students must be faced with situations that encourage the process of unitizing and conceptualizing the whole with as many shapes as possible in different units. That way will train students to hone their unitizing skills. When this unitizing ability is already possessed by students, then when faced with mathematical proportional reasoning problems students will be able to solve it well.

CONCLUSION

In this study students' mathematical proportional reasoning experiences several obstacles, namely: students when solving mathematical proportional reasoning problems have not been able to recognize additive and multiplicative relationships in recognizing the similarity of ratios, recognizing rational plausibility, and not being able to do unitizing.

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