Content knowledge of prospective elementary school teacher for fractional concepts

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Abstract. The aim of this study was to describe the content knowledge especially the concept of fraction of prospective elementary school teacher. The purpose of this study is to describe the content knowledge, especially the concept of fraction of prospective elementary school teacher. The subject of the study was one of prospective elementary school teacher of Pattimura University. This research is qualitative research. Data were collected through the provision of tests to explore the knowledge content of primary school teacher candidates about fractional concepts. Then continued with qualitative data analysis. The results of this study are as follows: that the prospective primary school teacher defines fractions as part of the whole if an object is divided into equal parts, so that the part that has been divided is part of the whole. Furthermore, the prospective elementary school teacher understood the fractions as division shown in two ways, namely the prospective elementary school teacher understood the fraction as a division operation, the primary school teacher candidate interpreted the fraction as a division when an object is divided be part of the same. Meanwhile, the fraction as a ratio is interpreted as the relationship between a pair of numbers. Then, the denominations are interpreted as a ratio between the numerator and the denominator of the same value. The prospective elementary school teacher also understands fractions of value when simplifying fractions. Primary school teacher candidates understand the concept of fractional operations.

1. Introduction

Primary school teacher education students are specifically prepared to become professional teachers who are expected to be able to teach almost all subjects in elementary school, one of which is mathematics. Mathematics is one of the subjects taught to students ranging from elementary to university level. At the elementary school level, the correct cultivation of mathematical concepts to students is essential, since the mathematical concepts will continue and are closely related to other mathematical concepts that will be taught at the next level of education. Mastery of mathematics material is one of the categories that must be mastered by teachers and prospective teachers who by Shulman (1986) called Pedagogical Content Knowledge (PCK). Ball (1990) defines PCK based on students and content knowledge, content learning and knowledge, and content curriculum and
knowledge. Furthermore, Ball (2000) argues that when preparing teacher candidates we need to identify the essential content knowledge needed in learning, how the knowledge needs to be understood, how knowledge is taught in the classroom. The combination of specific content knowledge and pedagogic knowledge is known as Pedagogical Content Knowledge (PCK). Mathematical knowledge and knowledge of mathematical representation are related to content knowledge, while student knowledge and learning knowledge are related to PCK. Meanwhile, according to An, Kulm and Wu (2004), there are three components of PCK namely subject matter knowledge, curriculum knowledge, learning knowledge. The elementary mathematics material consists of integers, fractions, geometry, and statistics. One of the mathematics materials in elementary school that is quite difficult and vulnerable to misconceptions in students is the concept of fractions. The difficulty in understanding the fractional concept is not only experienced by elementary students but also by most students. The difficulty appears in the errors that are often made by the student if given a matter related to the fractional material.

Based on the author's experience when teaching calculus courses, not a few students make mistakes in operating the fractions. In addition, the author's experience in teaching some courses in PGSD, when giving a problem related to fractions, many students make mistakes in solving the given problem. Errors students make vary. One example is, when the author gives a matter of summing the fractions with a different denominator, there are some students who solve the problem without equating the denominator, but directly sums the numerator with the numerator and sums the denominator with the denominator. Fractional concept is the basic concept that has been taught at primary school level and prospective elementary school teachers are prospective teachers who are prepared to teach at the primary school level. In addition, a deep understanding of a particular subject matter in this case math is very important. Fractional concepts must be well understood by elementary students because they become the basis for understanding other mathematical concepts in higher education.

Starting from some of the above, prospective elementary school teachers who are prepared to become elementary school teachers should be really prepared both in terms of mastery of material and delivery of material to students to be accepted and understood by students and should be familiarized to explain the material that is understood to students so that when there is a mistake in the delivery, can be fixed. In addition, with the mastery of good material from prospective teachers or teachers, prospective teachers or teachers can explain and improve misconceptions experienced by students. Preparing teachers to teach math effectively is one of the most pressing issues facing people who want to improve student learning (Morris, Hiebert, & Spitzer, 2009). Knowledge of prospective teacher content is an important focus for properly preparing teachers (Darling Hammond, 2000; Stohlmann, Moore, & Cramer, 2013).

The authors made initial observations of prospective elementary school teachers by giving some questions about the addition and subtraction of the same denominations and different sections. Based on preliminary observations, it was found that many students have not understood the concept of fractions correctly. This is seen through the work of students in adding the same fractions, the students still make mistakes. Some students solve the same amount of sums by multiplying by cross-sum then summing the numerator with the numerator and denominator with the denominator. As for the different problems disguised, most students equate the denominator by multiplying the denominator and then proclaiming the numerator. From some mistakes that happened, it turns out that there are still many students who do not understand about the concept of fractions worth, LCM, and GCD. The same error occurs when the student is asked to explain the answer to his friends. From some of the above, it appears that students' understanding of the basic concepts of mathematics is very low, even though these concepts have been studied since elementary school and will be taught by prospective students when they will become elementary school teachers.

Based on the above background, the purpose of this study is to describe the content knowledge of prospective elementary school teacher for the fractional concept material. Therefore, the question
formulation in this study is how content knowledge of prospective elementary school teacher for the fractional concept material?

2. Theoretical background

2.1. Mathematics teaching
Delivering information in the form of knowledge to someone, and then the person understanding what is delivered is one of the characteristics of good teaching. Hamali (2001: 44-53) suggests that teaching can be interpreted as (1) conveying knowledge to students, (2) passing culture to young generation, (3) the effort to organize the environment so as to create learning conditions for the students, (4) provide guidance to students, (5) preparing students to become good citizens, (6) a process of helping students face the daily life of the community. Associated with mathematics, according to Diene (1971), learning mathematics means understanding the relationship between symbols and relationships among others to obtain concepts that can be used in real life.

Based on the opinion of the experts above, the authors can conclude that teaching mathematics is the process of communicating information knowledge in the form of ideas and concepts of mathematics to students by using various ways in accordance with mathematical topics delivered in the hope that what has been delivered can be accepted with good and can be understood by students and can be applied in dealing with various problems in everyday life related to mathematics.

2.2. Pedagogical content knowledge
Shulman (1986) is one who introduces PCK (Pedagogic Content Knowledge) which is a slice of certain content knowledge and pedagogic. Based on Shulman's (1987) idea for PCK, effective teachers can have an indepth knowledge of how to represent subject matter to students (Parker & Heywood, 2000). Shulman (1987) also stated that PCK should include students' knowledge and their characteristics, knowledge of educational contexts, knowledge of outcomes, educational objectives and values, philosophical and historical basis of education. PCK leads to the ability of teachers to transform the content of learning materials in learning with a variety of methods that match the background of students' abilities.

PCK describes how specific subject matter is transformed to improve effective communication for teachers and students. Content knowledge refers to the body of knowledge and information that teachers teach and students are expected to study a given subject or content, such as English art, math, science, or social studies. Content knowledge generally refers to facts, concepts, theories, and principles taught and learned in the academic field rather than related skills such as reading, writing, or researching. Grossman (1990) describes four specific components of learning knowledge: (1) knowledge of strategy and representation of a particular topic of learning, (2) understanding of concepts and misconceptions of students on learning topics, (3) teacher knowledge and beliefs about specific learning objectives for students of different levels, covering their conceptions related to basic lessons and what topics are important for students to learn (4) curriculum material knowledge in learning. In line with the above opinion, Fennema and Franke (1992) determine the mathematics teacher's knowledge component as: (1) mathematical knowledge which includes knowledge of content consisting of the nature of mathematics and the mental organization of teacher knowledge, (2) knowledge of mathematical representation , (3) student knowledge, (4) knowledge of teaching and decision making. The first item is about having a conceptual understanding of mathematics. Fennema and Franke (1992) argue that if a teacher has a conceptual understanding of mathematics, it affects classroom teaching in a positive way; Therefore, it is important to have mathematical knowledge for teachers. Teachers and prospective teachers should be able to see the interrelationships between concepts taught because it is very important and is a procedural knowledge. Furthermore, Fennema and Franke emphasize the importance of knowledge about mathematical representation, since mathematics is seen as a composition of a very related set of abstractions. Fennema and Franke (1992: 153) state that if teachers do not know how to translate the abstraction into a form that allows learners
to relate mathematics to what they already know, they will not learn with understanding. Knowledge of mathematics and knowledge of mathematical representations related to content knowledge, while knowledge of students and knowledge of teaching is related to pedagogical content knowledge.

Based on the opinion of the experts above, it can be concluded that PCK includes the conceptual knowledge and procedural knowledge that students bring in the learning of a particular topic, misconceptions that may have developed in students, and understanding stages that students may skip from a little understanding of a particular topic to master the topic the. PCK also includes knowledge of techniques for assessing students' understanding and diagnosing their misconceptions, knowledge of teaching strategies that can be used to link what students learn with the knowledge they already possess, and knowledge of teaching strategies to eliminate misconceptions that have developed in student self. In this writing will be focused on the components of the PCK is the knowledge of mathematical content in this case the knowledge of prospective elementary school teachers in this case PGSD students about the fractional concept material.

3. Method research
This study aims to reveal the content knowledge of prospective elementary school teacher. This research is a qualitative research. The subject of this study is one student of prospective elementary school teacher Patimura University. A group of students will be given a math test. The results of the test were processed and categorized into three groups of highly skilled students (score ≥ 80), moderate math skills (65 ≤ score < 80), and low math skills (0 ≤ x < 65) ranging from 0 to 100. Subjects in the study were subjects with high mathematics ability category (S1). Data were collected through the provision of tests to explore the content of primary school teacher candidates about fractional concepts. Then continued with qualitative data analysis.

4. Result and discussion
This research was conducted at Pattimura University of prospective elementary school teacher study program. The subject of this study is one student of prospective elementary school teacher Patimura University. Prior to conducting the research, researchers first gave a mathematics ability test to prospective elementary school teacher Patimura University amounting to 60 students. The test of mathematical ability given in the form of essay which amounted to 9 questions. Based on the test results obtained one student who has a score of 85. The score belongs to the category of high ability. Thus, obtained the subject of research and given the code S1. After that, to explore the content knowledge of the students of primary school teachers, the researchers designed the test questions consisting of 3 questions about the meaning of fractions, fractions of value and simple denominations, and understanding in solving various problems related to the concept of fractions. Problem test is given to S1 to be completed.

Understanding S1 about the subject matter especially the fractional concept can be seen based on the answers given by S1 in answering 3 items of questions designed by researchers to explore the understanding of prospective elementary school teachers about the concept of fractions. The following is the details of the questions and answers S1.

Problem number 1. Explain the meaning of fractions!
S1 answer for number 1.
Based on the above data, obtained that S1 describes the meaning of fractions as part of the whole is pieces or parts of which each part has the same size that part or piece is part of something whole or whole. S1 gives a paper sample. The paper is cut into equal parts. S1 cut paper into 4 pieces of the same. according to S1, the piece of paper the piece is part of the whole paper. This shows that S1 has an understanding of fractions as part of the whole.

Furthermore, S1 defines fractions as division by giving an example of an object divided into equal parts. The object is an apple, an apple divided into two equal parts, so these two equal parts are the product of the division of an apple. Then, S1 exemplifies fractions as division: \( \frac{9}{12} \div \frac{10}{15} = \frac{9}{12} \times \frac{15}{10} = \frac{135}{120} \). GCD of 135 and 120 are 15 so \( \frac{135}{120} = \frac{9}{8} = 1 \frac{1}{8} \). S1 defines fractions as divisions by dividing two common fractions and applying the fractional operating properties of fractions. After obtaining the result of operation, the fraction is then simplified by finding GCD from the numerator and denominator. After obtaining the GCD, the numerator and denominator are divided by the GCD and get the simplest value. This means that S1 defines fractions as a division operation. Based on the explanation S1, it can be concluded that S1 views fractions as a division that lies in the division operation. Thus, S1 denotes a fraction as an object divided into equal parts and fractions as a division operation.

The meaning of fractions as a ratio, S1 gives an example of a ratio of money owned by 2 children. The question of the example given S1 is about the amount of money held by two children if it is known the ratio of the money of both children and the amount of their money. Furthermore, S1 determines the amount of money each child has by applying a comparable ratio. This shows that S1 interpreted fractions as a ratio seen from the ratio of the amount of money owned by the two children against the amount of their money. This shows that S1 interpreted fractions as ratio by looking at the relationship between a pair of numbers so it can be concluded that S1 understands fractions as a ratio.

Based on the data analysis of the number 1, obtained that S1 understands the meaning of fractions as part of the whole, fractions as a division and fractions as a ratio and it relates to factual knowledge and conceptual knowledge. So it can be said that S1 has an understanding of factual and conceptual knowledge related to the concept of fractions.

Problem number 2.
a) Explain the meaning of a equivalent fraction!, b) Explain the meaning of fractions $\frac{1}{2}, \frac{2}{4}, \frac{4}{8}$, c) Specify a equivalent fraction of $\frac{3}{5}$. Explain how you got a equivalent fraction!

S1 answer for number 2.

Based on the above data, obtained that S1 defines equivalent fractions is two forms of comparison between the numerator and denominator who have the same value. According to S1, fractions of $\frac{1}{2}, \frac{2}{4}, \frac{4}{8}$ are equivalent fractions. According to S1, a equivalent fraction can be obtained by multiplying or dividing the numerator and denominator with the same number. S1 explains that a equivalent fraction is a fraction that has the same value. To obtain a equivalent fraction, the fraction must be multiplied or divided by the same number. S1 gives an example, to determine equivalent fractions of $\frac{1}{2}$, then the $\frac{1}{2}$ fraction must be multiplied successively by 2, 3, 4 and so on and obtained fractions $\frac{2}{4}, \frac{3}{6}, \frac{4}{8}$. Equivalent fractions of $\frac{6}{10}$ are $\frac{9}{15}, \frac{12}{20}$, and $\frac{3}{5}$. This indicates that S1 understands the meaning of equivalent fractions, as well as how to determine a equivalent fraction. This also means that S1 understands how to simplify the fraction of searching for a fraction of value with the fraction in question in the simplest form of fraction.

Based on the data analysis of the number 2, obtained that S1 understands the meaning of equivalent fractions and it relates to conceptual knowledge. So it can be said that S1 has an understanding conceptual knowledge related to the equivalent fractions.

Problem number 3

If each child needs $\frac{3}{4}$ meters of ribbon, then 6 children need how many meters of ribbon section.

Explain your answer!

S1 answer for number 3.
Based on the above data, obtained that, S1 solve the problem in two ways. The first way, S1 writes the information known in the problem ie each child needs \( \frac{3}{4} \) meters ribbon. 6 children then \( \frac{3}{4} \times 6 = \frac{3}{4} \times \frac{6}{1} = \frac{18}{4} = 4.5 \). While the second way S1 write down the information known in the problem that is each child needs \( \frac{3}{4} \) meters ribbon. 6 children then \( \frac{3}{4} \times 6 = \frac{3}{4} \times \frac{6}{1} = \frac{9}{2} = 4.5 \). This shows that S1 understands the meaning contained in the matter of the story so that S1 can solve the problem well and can apply the properties of fractional multiplication operations.

Based on the data analysis of the number 3, obtained that S1 understands problems solving related to the concept of fractions and it relates to conceptual and procedural knowledge. So it can be said that S1 has an understanding of procedural knowledge that is problem solving related to the concept of fractions. It shows that, (1) S1 understand the meaning contained in the story so that S1 can solve problems related to the concept of fractions with well, (2) S1 understands fractional operations so as to apply the fractional operating properties.

5. Conclusion

The results above show that the prospective elementary school teachers interpret the fractions as part of the whole that is if an object is divided into equal parts, so that the part that has been divided is part of the whole. Furthermore, the prospective elementary school teacher understood the fractions as division shown in two ways, namely (1) the prospective elementary school teacher understood the fraction as a division operation; (2) the primary school teacher candidate interpreted the fraction as a division when an object is divided be part of the same. Meanwhile, the fraction as a comparison is interpreted as the relationship between a pair of numbers. The denominations are interpreted as the ratio between the numerator and denominator of the same value. The prospective elementary school teacher also understands fractions of value when simplifying fractions. Primary school teacher candidates understand the concept of fractional operations. This is shown when students can solve the story problem. In addition, prospective students have understood the meaning contained in the story and the prospective primary school teachers can solve the story well.

6. References

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