Constructing Based Mathematics Learning Bruner's Theory to Improve Learning Outcomes Grade IV students at SD Negeri 15 Ternate City

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ABSTRACT

This study aims to construct learning mathematics based on Bruner's theory to improve the learning outcomes of fourth grade elementary school students in studying the material for adding fractions with different denominators. The research approach used is a qualitative approach with a class action research design (CAR). Place of research, in SD Negeri 15 Kota Ternate. The subjects in this study were 4 students, taken one high ranking student, two medium ranking students, and one low ranking student. Data collection techniques in this study were student ability tests, observations, and interviews. The collected data were analyzed qualitatively and quantitatively. This research was conducted in 3 learning actions. Based on the results of this study it is suggested (1) in teaching fraction addition operations material, the teacher needs to relate the knowledge that students already have, namely the concept of fractions and the concept of equivalent fractions, (2) to teach the concept of arithmetic operations for adding fractions with different denominators, the teacher should make a learning plan through three stages of presentation namely the enactive stage, the iconic stage, and the symbolic stage by using a variety of teaching methods so that it is fun for students, (3) the teacher needs to know the difficulties and causes in learning the arithmetic operations of adding fractions with different denominators, and(4) the results of this study can be used as reference material for researchers, teachers who teach mathematics in elementary schools.

Keywords: *Bruner's theory, fraction addition operations, improvement*

INTRODUCTION

In the 2013 curriculum content standards for elementary schools it is stated that the scope of mathematics subjects includes numbers, geometry, measurement, and data processing (He dkk., 2023; Ina Sukma Dewi dkk., 2020; Makerere University, Kampala, Uganda dkk., 2021). Based on the curriculum, fraction material is part of numbers. Furthermore, material on fractions and operations is one of the teaching materials that is very important for studying mathematics further and is often used in everyday life (Walker dkk., 2020). In general, Ruseffendi (2008) states that fractional material is important both as a tool for learning advanced material, as well as guiding patterns of thinking, as well as forming students' attitudes toward mathematics.

However, when students study it, fraction material and its operations are always quite a challenge for students. Made Aryana, (2017) found that 87% of elementary school students had not been able to complete the addition and subtraction of simple fractions (Chesworth & Hedges, 2023; Kušnierik, 2024; Nundy dkk., 2022). The National Assessment of Educational Process report shows that only 39% of students aged 13 years can answer simple fraction operations such as $\frac{2}{3} + \frac{3}{4}$. This is confirmed by the results of the NAEP test that high grade elementary school students have a very weak understanding of fraction material and its operations. Sudjono (2013) argues that of the material in elementary schools, fractions occupy the most concerning position. This fact shows how complex the problems that occur in learning fractions. The difficulty of learning fractions turns out to be ongoing from time to time. This is understandable because currently teaching fractions tends to be teacher oriented and the implementation is not yet effective. On the one hand the teacher provides stimulus or stimulation by defining mathematical notions, on the other hand students respond by giving answers (reactions) to the stimuli given by the teacher (Gorbunova dkk., 2023; Maroušek dkk., 2020; Tercier-Waeber dkk., 2021).

It is time for students to be given the widest possible opportunity to develop themselves. Umar, et al. (2022) said that the role of the teacher as a giver of knowledge, it is time to shift to being a facilitator who facilitates students to be able to learn and construct their own knowledge. In the view of constructivism, students as actors construct their own knowledge through understanding, experience, and each other's initial abilities (Chibani & Merouani, 2021; Gohar dkk., 2021; Straub, 2021). The teacher's role as a facilitator also facilitates students who experience difficulties by allocating specifically so that these students can build their knowledge and understanding. The above facts should be able to support and facilitate the process of learning mathematics in schools.

Researchers conducted an introductory study at SD Negeri 15 Kota Ternate, found that many students found it difficult to solve fraction problems, especially in material for arithmetic operations with different denominators (Bashir dkk., 2022; Fan & Ji, 2022; Saadatmand dkk., 2021). The difficulties experienced by these students generally occur when solving fractional operations $\frac{1}{2} + \frac{1}{3} = \frac{2}{5}$. The mistake made was that

students answered by adding the quantifier with the quantifier and the denominator with the denominator. From the results of the pre-test it can be seen that the errors made by students are grouped into three types, namely: (1) conceptual errors, (2) procedural (algorithm) errors, and (3) technical errors (miscounting). Student errors in answering fraction addition operations questions by 58%. In general, there are two main obstacles in learning mathematics in elementary school, especially the concept of fractions and their operations, as well as modeling for these two sub-subjects. In elementary mathematics learning, both require in-depth attention and discussion. Because of that, tracing students' difficulties in the concept of fractions and their operations is an effort that must be made to improve achievement/outcome of mathematics learning for elementary school students. (Ahamad dkk., 2020; Castro & Tumibay, 2021; Liu dkk., 2021) suggests that to teach fractions and their operations, teachers should use concrete media (visual aids) in the teaching and learning process.

Teaching fractions is not only about transferring mathematical ideas, methods and concepts, but it is rather a way of defining fractions as a process of (gradual) origin, occurrence and development. (Abokersh dkk., 2020; Beede dkk., 2020; Yadav dkk., 2020) revealed that to start learning fractions, teachers need to connect a math topic with real life, which is known as a contextual approach. Studentconstruct their own mathematical concepts. The constructivist view suggests the following approach: the teaching of mathematics at all levels must provide students with opportunities to: gain practical and concrete experiences, investigate and seek relationships, find patterns and solve problems, talk about mathematics, formulate results and solutions, give reasons, and draw conclusions (Ma dkk., 2021). It will be more effective if teaching is "set" in such a way that it is fun, students learn happily.

Meanwhile, according to Bruner's theory, learning is an active process in which students construct new ideas or concepts based on prior knowledge. Students select and modify information, construct hypotheses, and make decisions based on cognitive structures (Loey dkk., 2020; Sharma & Guleria, 2023). According to Bruner that development in learning explains, that "teaching a lesson to students at any age can introduce a scientific structure to the lesson as long as it is adapted to the way students think". Based on the theory he put forward, Bruner suggested teaching scientific disciplines to students, resulting in what is called the transfer of training, namely understanding the scientific structure which causes the learning material to become more comprehensive.

Based on the problems above, we need a learning model that is considered appropriate that can bridge these problems, namely constructing mathematics learning based on Bruner's theory which includes the stages: enactive, iconic and symbolic. This learning model provides opportunities for students to discover and reconstruct the concept of fractions and their operations. Thus, the formulation of the problem set is how to construct learning using Bruner's media in an effort to improve the learning outcomes of fourth grade elementary school students in studying addition operations of fractions with different denominators?

RESEARCH METHODOLOGY

This study aims to construct mathematics learning using Bruner's media to improve the learning outcomes of fourth grade students at SD Negeri 15 Kota Ternate in learning the arithmetic operations of adding fractions with different denominators (Alkadi dkk., 2021; Thurnhofer-Hemsi & Domínguez, 2021). This study emphasizes more on the learning process. A good learning process is expected to provide good learning outcomes. In this study, the researcher is the main instrument. This is because researchers plan, design, implement, collect data, analyze data, make conclusions and make reports. This is consistent with the characteristics of qualitative research.

The data collected in this study are (1) the results of student work on LKPD, pre-test and post-test; (2) results of observations of student activities and results of observations of teacher activities in learning; (3) results of interviews with research subjects. The source of the data in this study were fourth grade students at SD Negeri 15 Kota Ternate for the 2022/2023 academic year who took part in learning how to add fractions with different denominators. While the research subjects were taken by 4 students consisting of 1 student with high ability, 2 students with moderate ability, and 1 student with low ability. Data collection procedures carried out were

tests, observations and interviews. The test is given to find out the increase in student learning outcomes based on the question indicators. Observation sheets were made with the aim of obtaining an overview of student and teacher activities during the learning process. Interviews function as a method for assessing the effectiveness of learning, as well as to determine students' attitudes towards learning. The research was carried out in 3 learning cycles, namely cycle 1 was learning the concept of fractions, cycle 2 was learning the concept of equivalent fractions and cycle 3 was learning arithmetic operations with different denominators. This classroom action research follows the spiral model of Kemmis and Taggart (Aghvami-Panah dkk., 2022; Chan, 2023; Mora dkk., 2020) which is a flow of action that takes place in repeated cycles. Each cycle consists of planning, implementing actions, observing, and reflecting through the steps of Bruner's theory.

Data analysis used in this research is qualitative and quantitative analysis. The data were analyzed by describing the data, quantitatively analyzing the data in the form of scores, and concluding the data. The data conclusions are adjusted to the criteria set out in this study. While the criteria for the success of the action are determined based on the mode level of increasing student learning outcomes. Indicators of the success of the learning process are determined by observing the activities of students and teachers using observation sheets. In other words, if each action is said to be successful if 85% of all students in the class reach ≥ 65. This means that each action is said to be successful if 85% of students in the class have reached a grade level of 65 or more about the material provided.

RESULT AND DISCUSSION

Based on the results of observations and field notes of researchers and observers during research activities through 3 stages namely the enactive stage, the iconic stage, and the symbolic stage, the following things were obtained. (1) high-ability students (S1), from the beginning of implementing cycle 1 actions to the end of cycle 3 actions, enjoy studying in groups/pairs. In the action cycle 1 can understand the concept of fractions well. Student activities in the enactive stage, iconic stage, and symbolic stage are students being asked to write the numerator and denominator of fractions $\frac{1}{2}, \frac{2}{3}, \frac{3}{4}, \frac{4}{5}, \frac{5}{6}, \frac{6}{8}, \frac{8}{10}$, And $\frac{9}{12}$. In other words, students' understanding of the concept of fractions increases, with an ideal maximum score of 100% both when working on worksheets and on the final action test. Furthermore, (2) medium grade students (S2 and S3) like to work in groups. The average percentage of achieving a score of representation ability starting from the concept of fractions to the operation of calculating fractions with different denominators through the enactive stages, iconic stages, and symbolic stages by Masters doing 94% LKPD and at the end of the action test 100%. The average score of moderately capable students in working on LKPD was 99.5% and in the final action test 96%. While (3) low ranking students (S4), tend to work alone. The average percentage of the ability score achieved by S4 is 72% working on the LKPD and 78% in the final action test.

When compared to the abilities of the four research subjects, S1 is the most consistent in creating and presenting the concept of fractions and operating the addition of fractions with different denominators through the enactive, iconic, and symbolic stages correctly. Students enjoy learning about the concept of fractions, equivalent fractions, and arithmetic operations on fractions with different denominators through the stages of Bruner's theory (enactive, iconic, and symbolic). The use of contextual media and the use of Bruner's theoretical model props for the concept of fractions, the concept of equivalent fractions and the concept of arithmetic operationson fractions with different denominators makes students enjoy participating in learning mathematics in class. In general, students actively work in pairs. According to students, by working together it will be easy to solve problems because they can help each other, discuss. In the presentation of the symbolic stage students can transfer the knowledge they have at the enactive and iconic stages and are linked to the symbolic stage. Student activities at the symbolic stage are students adding up the following fractions with an equivalent fraction approach. These fractions are $\frac{1}{3} + \frac{4}{9}, \frac{2}{6} + \frac{5}{12}$. The teacher conducts questions and answers to explore students' understanding of the concept of adding fractions with different denominators. The results obtained indicate that students have done the arithmetic operation of adding fractions with different denominators correctly.

Thus, learning through the enactive, iconic, and symbolic stages, students gain an understanding of the concept of equivalent fractions and fractions as prerequisite material for understanding the material for adding fractions with different denominators. This prerequisite knowledge is important for students to understand. In the opinion of

Ruseffendi (2008) that prerequisite knowledge or basic knowledge must be owned by students and is the main requirement in learning, because students will not be able to follow the learning properly without prerequisite material knowledge. This is as the results of the final action test showed that the three research subjects had gained understanding and increased learning outcomes in the concept of fractions, equivalent fractions and addition operations for fractions with different denominators with an absorption power of up to 94%.

CONCLUSION

Based on the results of the research and discussion, it can be concluded (1) learning through the stages of Bruner's theory (enactive, iconic, and symbolic) can improve student learning outcomes on the concept of fractions, equivalent fractions and the concept of addition operations for fractions with different denominators; (2) the ability of high ranking students (S1) is at the ideal maximum score of 100% both when working on LKPD and on the final test of learning actions; (3) the ability of medium-ranked students (S2 and S3) is at an average achievement score of cycle 1 to cycle 3 in working on LKPD and the final test of learning action by 98%; (4) the ability of low ranking students (S4) is at an average achievement score of cycle 1 to cycle 3 in working on LKPD and the final test of learning action by 75%. However, low ranking students (S4) tend to work alone; (5) the absorption power reaches 94% of the four students as research subjects. The results of the interviews with the research subjects revealed that the answers of the research subjects were consistent with the results obtained by the research subjects in the action/learning final test.

Thus it can be suggested as follows: (1) in teaching fraction addition operations material, the teacher needs to relate the knowledge that students already have, namely the concept of fractions and the concept of equivalent fractions, (2) to teach the concept of arithmetic operations for addition of fractions with different denominators, the teacher should make a plan learning through three stages of presentation, namely the enactive stage, the iconic stage, and the symbolic stage by using various teaching methods so that it is fun for students, (3) the teacher needs to know the difficulties and causes in learning the arithmetic operations of adding fractions with different denominators; and (4) the results of this study can be used as reference material for researchers, teachers who teach mathematics in elementary schools.

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