

Analysis of Fraction Material Presentation Based on Bruner's Learning Stages in the Mathematics Textbooks of the 2013 Curriculum in Grade Iv

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Abstract: This study aims to examine the material presentation of fraction in the mathematics textbooks of the fourth grade elementary school based on Bruner's theory. Bruner's theory prioritizes the level of thinking or cognitive of students in the acquisition of mathematical concepts, especially fractions, and prioritizes the process of knowledge construction by students. This is a descriptive study which used content analysis technique. Data collection method used was documentation method. The documentation method was used to obtain data about the material presentation of fraction in mathematics textbooks. The instrument used was in the form of analysis sheets of fraction material presentation based on Bruner's learning stages. The overall percentage of the Bruner's learning stages applied to the presentation of fraction material is that the enactive stage is of 49%, the iconic stage is of 69%, and the symbolic stage is of 89%. Presentation of fraction material in mathematics textbooks is included in the good category, but is less concerned with the acquisition of concrete object-based concepts, so that it is considered less concerned with thinking stage of elementary school age children who are still at the concrete operational stage that is still in need of concrete objects in the acquisition of concepts or knowledge.

Keywords: Fractions, Mathematics Textbooks, Bruner's Theory

1. INTRODUCTION

Learning resource is a supporting component in teaching and learning activities. Learning resources that are often used in schools are generally printed; one of which is a textbook. According to Tarigan (2009: 23), textbook is a learning book used in certain fields of study that have been standardized and compiled by experts in their fields and is equipped with facilities that ease the user so that it can support the learning process. Darwati (2011: 76) stated that the use of textbooks is essential in learning activities in which it not only functions as a source of learning, but also as a medium and learning tool, as an instrument of learning assessment, and as a way to increase students' motivation and interest in learning..

Regulation of the Minister of Education and Culture of the Republic of Indonesia No. 24 of 2016 concerning Main Competencies and Basic Competencies of Learning in the 2013 Curriculum states that the implementation of learning in Elementary Schools/Islamic Elementary Schools (SD/MI) is carried out with an integrated thematic approach, except for mathematics and physical education, sports and health (PJOK) subjects as a stand-alone or separate subject for high classes, namely grade IV, V and VI.

The scope of mathematics material in elementary schools is fractions. Fraction is an important material in learning mathematics. It is regarded to be important because it needs skills, mastery, and comprehension of concepts that need to pay attention to the level of students' thinking.

Fraction numbers are widely used in daily life (Hobri, 2018:1). Fraction material, that is close to the environment of students, should be presented by providing examples of concrete implementation, because it is often presented in the form of abstract concepts. Therefore, fraction material should be learned through concrete objects or compilation by using visual objects before being directly presented in the form of abstract symbols, because in addition to influencing students' understanding of the fraction concepts, it can also prevent fraction misconceptions done by students. For example, the concepts of fractions such as equal division, equality fractions, addition and subtraction of fractions. Suciati and Wahyuni (2018: 138) revealed that mostly students made misconception in the fraction addition operation of the unequal denominator..

The use of concrete media makes students better understand the concept of fractions (Winarso and Yuliyanti, 2017: 23). Piaget (in Karwono and Mularsih, 2017: 89), expressed that elementary school age children (age range of 7-11 years) are at a concrete operational stage that is marked by starting to be able to think logically but still limited to concrete objects, so that they cannot understand the abstract concepts. Hence, fraction material taught to students must be in accordance with the development stage of children's thinking/cognitive. This certainly must be in line with the presentation of fraction material in mathematics textbooks. The 2013 curriculum mathematics textbook should also be

presented in accordance with the development stage of children's thinking in the acquisition of concepts.

Mathematics textbook analysis is carried out to find out the material presentation, especially the fraction material in the mathematics textbook. The book analyzed is the book of "*Dunia Matematika*" by Indriyastuti. This book is used in several elementary schools in Jember Regency such as Public Elementary School of Kebonsari 04, Public Elementary School Kebonsari 02, and Public Elementary School Jember Lor 05, and has been declared eligible based on the Ministry of Education and Culture Decree No. 147/P 2016 concerning the determination of the titles of textbooks in mathematics and Physical Education Sports and Health (PJOK) for grade IV of Elementary School/Islamic Elementary School. This book is analyzed based on Bruner's learning theory, because this theory emphasizes the thinking level of students and the process of knowledge construction by students ranging from the acceptance of knowledge, transformation of knowledge, evaluation or assessment making ability of the knowledge that has been obtained.

According to Bruner (in Aisha, 2007: 1-6), the learning process by students will occur optimally if the learning process goes through three stages of thinking according to Bruner, namely the active, iconic and symbolic stages. (1) The enactive stage, namely in learning activities in the acquisition of concepts, students manipulate concrete objects. (2) The iconic stage is the learning activities of knowledge or concepts presented through visual objects, in the form of images, diagrams and tables. (3) The symbolic stage is the presentation of learning by using abstract symbols, either in the form of verbal symbols or mathematics symbols.

The implementation of Bruner's learning theory in mathematics learning is considered being able to increase students' learning activities and learning outcomes. It is same as the research that has been done by Pramudita, et al (2019). Wijayanti and Fitriani (2015), revealed that using Bruner's theory-based learning tools in fraction learning can improve students' learning abilities and achievement. Haidar (2019) stated that the material presentation in the mathematics textbook of the 2013 curriculum is actually fairly good, but it still does not fit the presentation of the geometry concept with Bruner's learning stages. In addition, the research conducted by Loc, et al (2017) concluded that the fraction material presented in the mathematics textbook is directly presented in the form of visual images and abstract symbols without any concrete object-based learning activities, so that students are lack of comprehension on the concept of fractions. Based on the explanation, the research problem in this study is "how is the presentation of fraction material in mathematics textbooks based on Bruner's learning stages?"

2. RESEARCH METHOD

The type of research used in this research is descriptive research with content analysis technique which

aims to analyze the content of fraction material presentation with the Bruner learning stage in mathematics textbooks for grade IV elementary school in the 2013 curriculum. Data collection methods used were documentation methods. The documentation method was used to obtain data about the presentation of fraction material in mathematics textbooks. The data source in this study was the fourth grade elementary school mathematics textbook in the 2013 curriculum with entitled "*Dunia Matematika untuk Kelas IV SD*" by Indriyastuti, published by PT Tiga Serangkai Pustaka Mandiri with ISBN 978-602-320-314-7. The object of study material is each material in the fraction chapter in the mathematics textbook of the 4th grade of elementary school.

Data presentation of fraction material according to Bruner in the mathematics textbooks of the fourth grade in the 2013 Curriculum which has been obtained from 3 stages of Bruner's learning will be processed in the form of equations:

$$p = \frac{srt}{smt} \times 100\%$$

Remarks:

p = the percentage of fraction material presentation in the mathematics textbooks based on Bruner's learning stage

srt = the score obtained at each Bruner's stage

smt = the maximum score that can be achieved

The percentage of results of fraction material presentation in the book will be included in the presentation category as shown in Table 1 below.

Table 1. Percentage Category of Fraction Material Presentation in Textbooks

Percentage of Material Presentation	Category of Material Presentation
$80\% < p \leq 100\%$	Very Good
$60\% < p \leq 80\%$	Good
$40\% < p \leq 60\%$	Moderate
$20\% < p \leq 40\%$	Deficient
$p \leq 20\%$	Very Deficient

Modification from Masyhud (2016:243)

3. RESULTS AND DISCUSSION

Based on the analysis that has been done, the results of the percentage of each fraction material in the fraction chapter can be seen in Table 2 as follows.


Table 2. Percentage of Learning Phases of Fraction Materials According to Bruner

No	Material	Learning Stages	Percentage
1.	Fractions	Enactive	40%
		Iconic	80%
		Symbolic	73%
2.	Equal fractions	Enactive	87%

No	Material	Learning Stages	Percentage
3.	Fractions forms	Iconic	100%
		Symbolic	100%
		Enactive	33%
4.	Estimates	Iconic	47%
		Symbolic	93%
		Enactive	40%
5.	Fraction implementation	Iconic	47%
		Symbolic	93%
		Enactive	47%
		Symbolic	87%

Based on Table 2, the results of the percentage accumulation of Bruner learning stages applied as a whole to the fraction material are the enactive stage is of 49%, Iconic is of 69%, and the symbolic stage is of 89%. From the analysis result percentage of the learning phase implementation that has been obtained, it can be seen that the mathematics textbooks of the fourth grade of elementary school have a tendency at the symbolic stage in presenting fraction material.

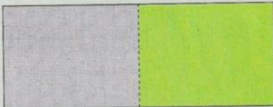
The implementation of the enactive stage in mathematics textbooks can be seen by using concrete objects in the environment around students. In fraction material in the mathematics textbooks, the activity of exploring concrete objects is only found in equal fraction material. The examples of the implementation of enactive stage in fraction material can be seen as follows.

Aktivitas Siswa  **Discovery Learning**

Menunjukkan Ada Banyak Sekali Pecahan Senilai dengan Suatu Pecahan

Kita akan menunjukkan ada banyak sekali pecahan yang senilai dengan $\frac{1}{2}$ dengan menggunakan 1 lembar kertas yang berbentuk persegi panjang.

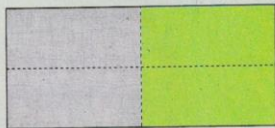
Langkah 1:
Lipatlah 1 lembar kertas menjadi dua bagian. Kemudian, bukalah kembali. Warnailah salah satu bagiannya. Nilai pecahan yang menunjukkan bagian yang diwarnai adalah $\frac{1}{2}$.
Kita akan menunjukkan bahwa ada banyak sekali pecahan yang senilai dengan pecahan tersebut.



Gambar 1.25 Kertas yang dilipat sekali.

Figure 1a. Step 1 Folding the Paper Once

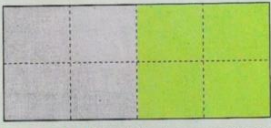
Langkah 2:
Posisikan kembali lipatan kertas pada langkah 1. Lanjutkan dengan melipatnya sekali lagi. Kemudian, bukalah dan hamparkan.



Gambar 1.26 Bentuk kertas yang dilipat dua kali.

Figure 1b. Step 2 Folding the Paper Twice

Langkah 3:
Posisikan kembali lipatan kertas pada langkah 2. Lanjutkan dengan melipatnya sekali lagi. Nilai pecahan yang menunjukkan bagian yang diwarnai adalah $\frac{1}{4}$.
Nilai pecahan yang menunjukkan bagian yang diwarnai adalah $\frac{1}{4}$.



Gambar 1.27 Bentuk lipatan yang ketiga kali.

Figure 1c. Step 3 Folding the Paper Three Times

Langkah 4:
Posisikan kembali lipatan kertas pada langkah 3. Lanjutkan dengan melipatnya sekali lagi.

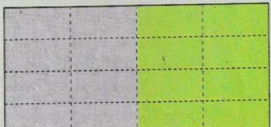


Figure 1d. Step 4 Folding the Paper Four Times

Nilai pecahan yang menunjukkan bagian yang diwarnai adalah $\frac{1}{16}$.
Coba perhatikan dengan cermat. Apakah pecahan-pecahan yang kalian peroleh pada langkah 1, 2, 3, dan 4 sama?
Apa yang dapat kalian simpulkan?
Jika kalian melakukannya dengan benar, kalian akan memperoleh

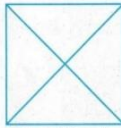
$\frac{1}{2} = \frac{2}{4} = \frac{4}{8} = \frac{8}{16}$

Figure 1e. Conclusions from Step 1 to Step 4

In Figure 1a to Figure 1d, there are paper folding activities carried out by students from step 1 to step 4 to determine or to find fractions that are equal to fractions. The students can conclude after doing paper folding activities that the equal fractions are $\frac{1}{2}, \frac{2}{4}, \frac{4}{8}, \frac{8}{16}$. The application of the iconic stage in the presentation of fraction material in mathematics textbooks has been found in several materials such as in the materials of fractions and equal fractions. The examples of the iconic stage application can be seen as follows.


1. Memahami Pecahan Melalui Gambar

Coba perhatikan contoh lain seperti gambar di samping. Sebuah kertas berbentuk persegi. Kertas itu dibagi menjadi empat dengan bentuk seperti pada gambar di samping.



Gambar 1.4 Persegi yang dibagi menjadi 4 bagian yang sama.

Sekarang, amati dan lengkapilah!

a.  **Gambar 1.5** Bagian dari keseluruhan. Daerah yang diarsir mewakili 1 dari 4 bagian, ditulis $\frac{1}{4}$.


b.  **Gambar 1.6** Bagian dari keseluruhan. Daerah yang diarsir mewakili ... dari ... bagian, ditulis $\frac{2}{4}$.

Figure 2a. The Example of the Iconic Stage Application of Fractions Material

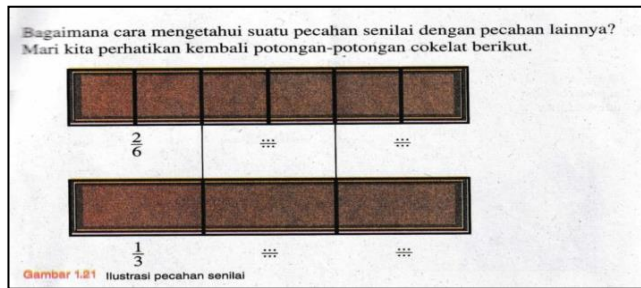


Figure 2b. The Example of the Iconic Stage Application of Equal Fractions Material (Chocolate)

In Figure 2a, there has been a student activity which identifies the numerator and denominator of fraction-based objects in a visual shape of a plane embodiment of paper.

It can be seen in Figure 2b that the students' activities do not identify equal fractions by using an embodiment image of chocolate bars.

The application of the symbolic stage has been applied to textbooks in each fraction material. One of the examples of the symbolic stage application can be seen as follows.

Portofolio Kreatif

Menemukan Pecahan Senilai Melalui Tabel Perkalian

Pecahan yang senilai dengan $\frac{1}{2}$ ada banyak sekali. Misalnya, $\frac{2}{4}, \frac{4}{8}, \frac{5}{10}, \dots$

Kita dapat memperoleh pecahan-pecahan senilai tersebut dengan banyak cara. Di antaranya adalah dengan menggunakan tabel perkalian.

Coba kalian perhatikan tabel perkalian dari 1×1 sampai 5×5 di samping.

Dari tabel perkalian tersebut, kita dapat menentukan pecahan-pecahan senilai. Perhatikan bilangan yang dilingkari.

Baris pertama sebagai pembilang dan baris kedua sebagai penyebut.

Dua bilangan yang dilingkari paling kiri (atas dan bawah) mewakili pembilang (atas) dan penyebut (bawah).

Akan kita dapatkan

Pembilang : 1
 Penyebut : 2

Pecahan yang diwakili adalah $\frac{1}{2}$.

Pecahan-pecahan yang senilai dengan $\frac{1}{2}$ adalah $\frac{2}{4}, \frac{3}{6}, \frac{4}{8}, \frac{5}{10}$ (lihat pada tabel).

×	1	2	3	4	5
1	1	2	3	4	5
2	2	4	6	8	10
3	3	6	9	12	15
4	4	8	12	16	20
5	5	10	15	20	25

Gambar 1.31 Mencari pecahan senilai melalui tabel perkalian.

Figure 3. Example of Symbolic Stage Application (Multiplication Table)

In Figure 3, there are students' activities exploring symbols in the form of numbers in multiplication table to find the concept of equal fractions.

Based on the analysis result that has been done, it can be seen that the application of the Bruner's learning stages depends on the material presented. If the material presented needs notation or symbols in the acquisition of the concept, for example as in the material of fraction forms and estimates, then the more or dominant learning stage is used, namely the symbolic stage. The application of the three

learning stages according to Bruner is also influenced by factors of the development stage or cognitive level of students.

According to the theory conveyed by Piaget that children at the elementary age of 7-11 years are still in the concrete operational stage. Piaget (in Karwono and Mularsih, 2017: 89) stated that children at the concrete operational stage can begin to think logically but still need and are limited to concrete objects. Children at this stage have not been able to solve problems or understand abstract concepts. Therefore, material or concepts in mathematics textbooks should also be able to prioritize students' cognitive development in acquiring concepts, by providing students active activities to manipulate or explore concrete objects, so that mathematics material or concepts can be better understood by students.

Based on the results, it can be considered that the mathematics textbooks of the fourth grade of elementary school that have been analyzed can be used as a source of learning support in learning fractions material so that it can support the achievement of learning objectives and optimal learning outcomes. It is in line with the results of research conducted by Pramudita, et al. (2019) showing that by applying the Bruner's theory to the learning of fraction material, it can increase the activity and learning outcomes of students. In addition, the research done by Winarso and Yuliyanti (2017) proved that by using teaching materials that have implemented the three stages of Bruner's learning, it showed that students were better able to answer questions related to the use of concrete objects in daily life (enactive stage). In accordance with the research of Haidar (2019) revealing that the concept of geometry in mathematics textbooks is not in accordance with Bruner's learning stages. Similar to the research by Loc, et al. (2017), it showed that the presentation of fraction material in mathematics textbooks is directly presented by using images and abstract symbols so that it is not concerned with the stages of thinking or cognitive development of students in the acquisition of the concept of fractions.

4. CONCLUSION

Based on the results and discussion that have been explained, it can be concluded that the percentage of fraction material presentation in the mathematics textbooks of the fourth grade is based on the Bruner's learning stages for the whole fraction material, namely applying the enactive phase of 49%, the iconic stage of 69%, and the symbolic stage of 89%. Presentation of fraction material in mathematics textbooks is included in the good category, but is less concerned with the acquisition of concrete object-based concept of fractions, so that it is considered less concerned with the thinking stage of elementary school age children who are still at a concrete operational stage that is still in need of concrete objects in the acquisition of concepts or knowledge. The application of the three stages of Bruner's learning depends on the cognitive development of the

students. The higher the thinking level of students, the more abstract the thinking way of students so that they do not need concrete objects in obtaining a concept or knowledge.

5. REFERENCES

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