DEVELOPMENT OF LEAFLET BASED ON THE BRUNER THEORY ON THE MATERIALS OF THE TWO-VARIABLE LINEAR EQUATION SYSTEM

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Abstrak

Penelitian ini bertujuan untuk mengembangkan *leaflet* berbasis teori Bruner untuk materi Sistem Persamaan Linier Dua Variabel yang valid dan mendeskripsikan karakteristiknya. Penelitian pengembangan digunakan menempuh tiga tahap yaitu analisis muka belakang, perancangan prototipe dan penilaian. Instrumen berupa lembar validasi produk dirancang untuk mendapatkan penilaian dari *expert* matematika, pendidikan matematika dan media pembelajaran. Aspek yang dinilai meliputi validitas isi, konstruk, grafik dan bahasa. Analisis data menggunakan rumus persentase dan hasil yang diperoleh dibandingkan dengan kriteria kualifikasi kevalidan suatu produk. Selanjutnya dideskripsikan karakteristik *leaflet* tersebut. Hasil validasi untuk semua aspek tergolong sangat valid. *Leaflet* berbasis teori Bruner yang sudah dinyatakan sangat valid oleh tiga validator masih perlu perbaikan, khususnya aspek bahasa. Berdasarkan penilaian dan saran *validator*, akhirnya diperoleh karakteristik *leaflet* berbasis teori Bruner untuk materi SPLDV yang valid yaitu *leaflet*: sesuai dengan tujuan pembelajaran SPLDV, sesuai untuk siswa yang memiliki minat baca dan pemahaman konsep yang rendah, berdasarkan pengalaman nyata siswa, memuat gambar-gambar yang unik, warna yang menarik, dan bentuk penulisan yang bagus, memuat kalimat motivasi yang dikutip dari tokoh-tokoh terkenal, dan memuat materi yang disajikan mengikuti tahapan teori Bruner.

Kata kunci: *leaflet*; pengembangan; sistem persamaan linier dua variabel; teori Bruner.

Abstract

This study aims to develop a leaflet based on Bruner's theory for the two-variable linier equation system, which is valid and describes its characteristics. Research development is used to take three stages, namely the prelimanary reseach, prototipe design and assessment. The instrument in the form of a product validation sheet was designed to obtain an assessment from an expert in mathematics, mathematics education and learning media. Aspects assessed include content validity, constructs, graphics and language. Data analysis uses the percentage formula and the results obtained compared with the validity qualification criteria of a product. Furthermore, the characteristics of the leaflet are described. Validation results for all aspects are classified as very valid. Bruner's theory-based leaflets that have been declared very valid by three validators still need improvement, especially aspects of language. Based on the validator's evaluation and validator's suggestion, finally obtained the characteristics of the Bruner theory-based leaflet for valid SPLDV material namely leaflets: in accordance with the learning objectives of SPLDV, suitable for students who have low interest in reading and understanding concepts, based on students' real experiences, containing unique drawings, attractive colors, and good writing forms, containing motivational sentences quoted from

famous figures, and containing material presented following the stages of Bruner's theory.

Keywords: Bruner's theory; development; leaflet; system of two-variable linear equations.

INTRODUCTION

The fundamental objective of studying mathematics at junior high school is to help students to understand the concept of mathematics (Permendikbud No. 58, 2014). Some indicators for achieving the objectives include the ability of students to re-identify understanding, classify objects, give examples and not examples, identify the characteristics of operations or concepts, etc.

Permendikbud No. 22 in 2016 explained the purpose of learning mathematics that teacher must carry out a learning process that meets the standards of the learning process. Teachers should develop and implement effective learning and attention to the needs of student. Learning devices to be developed by teachers are not only limited to the syllabus and learning implementation plan, but also equipped with teaching materials or learning media.

Some literature shows that inaccuracy in the selection and use of teaching materials is becoming one of the barriers to achieving the objectives of mathematics learning (Netriwati & Lena, 2017; Purnomo, 2011). Indeed, the use of proper teaching materials can encourage motivational learning (Winarso & Yuliyanti, 2017) and independence of learning students (Riswinarni & Sulisworo, 2016). ineffectiveness of the use of teaching materials is due to the fact that teaching materials do not comply with the characteristics of the student, the characteristics of the learning materials and do not facilitate the learning of mathematical thinking skills.

Preliminary research in SMPN 2 Pariangan, Tanah Rata, West Sumatra was identified in March 2019 as a number of problems indicating that the learning process of student mathematics has not been maximized. Based on Daily Exam results (UH) from two-variable linear equation systems (SPLDV) material, 3 out of

32 students are completed. In this context the percentage of students earning the value under the Minimum Completity Criteria (KKM) is high.

In addition, search through interviews with students who are not complete, obtained information that they are difficult to understand the concept of SPLDV. According to them, the reference book does not help them understand the concept. Students argue that the language or sentence of the book is difficult to understand. In addition, the material presentation does not conform to their initial proficiency level. Students also acknowledge that their reading interest is low. Moreover, students read a quite thick book alone.

This problem does not happen only in SMPN 2 Pariangan, but also happens in the middle of the junior high School of West Sumatera province. This is derived from the interview with Tadris Mathematics students who have carried out field practice (PL) in junior high school which is spread in the West Sumatera province. Therefore, it is necessary to do the effort to overcome it.

One solution is to develop teaching materials which fit the characteristics of students, the characteristics of the SPLDV material, and facilitate students to acquire a mathematical skill (Purnomo, 2011; Safitri, 2019). Based on the results of the preliminary study, the teaching materials that relating to the students' characteristics are simple, practical, and interesting teaching materials. Teaching materials that have such characteristics as leaflets (Riswinarni & Sulisworo, 2016).

Like other teaching materials, leaflets contain mathematical objects, either directly or indirectly. Therefore, the presentation of leaflets should pay attention to the learning approach that relating to the mathematical object that will be presented. For example SPLDV material. SPLDV is a set of multiple equations that contain two variables. Solution of SPLDV by finding all sorted pairs of the system (Barnett dkk., 2008).

Considering SPLDV classified as abstract material, the presentation of material on leaflet requires creativity of teachers to make it more contextual (Widjaja, 2013). Teachers should consider the cognitive development of students. According to Aini & Hidayati (2017), student of junior high school in Indonesia are still not entering a formal operation stage.

The solutions offered by some previous researchers (Safitri, 2019; Sari, 2019; Winarso & Yuliyanti, 2017) that using Bruner theory to approach the presentation of SPLDV material on leaflets. Bruner theory consinst of the enactive, iconic and symbolic that can help students more easily understand algebraic material (Bentina dkk., 2013). However, many researchers have previously carried out development leaflets based on Bruner theory for mathematical learning, but the developed leaflets are still limited to concrete mathematical materials such as three-dimensional objects and function graphs. There is still a few development of leaflets for abstract mathematical materials such as the two-variable linear equation system. This is the novelty of this research compared to previous research. In addition, leaflets developed in accordance with the characteristics of junior high school students in West Sumatera province, especially for students who have a low interest read and difficult to understand SPLDV material from the reference book.

The problem in this study is how the leaflet on two-variable linear equation system applicable based on Bruner 's theory? The answer is obtained by developing leaflets. The results of this study serve as leaflets for teachers and prospective mathematical teachers in mathematical education.

METHOD

This research uses development research. Development research is chosen because through this research can be generated learning products such as mathematical leaflets, so as to overcome the problem of mathematics learning (Plomp, 2007). The development model refers to the model expressed by Plomp which consists of preliminary research, prototype design, and assessment.

The leaflet validation sheet is used as a data collection tool. The four validity types contained in the validation sheet include validated content, graphics, a construct, and a language. These types of validations refer to the standards of Education National Standards Agency (BSNP). A description of the four aspects of validity can be seen in table 1.

Table 1. Description of validity aspects on the validity sheet

Aspect	Description
Content	Leaflet based Bruner theory designed in accordance with the mathematical curriculum for odd semester in second grade of junior high school
Graphics	Illustration, layout and design of the leaflets based on Bruner theory that is able to make student that interested
Construct	The conformity of Bruner theory-based leaflet components with established basic competency indicators
Language	Leaflets based on the Bruner theory are designed based on well structure

The validation sheet is assessed by three validators i.e. mathematician lecturer, Learning Media lecturer and mathematics education lecturer. The assessment criteria on the validation sheet is 1 (invalid), score 2 (valid enough), score 3 (valid) and score 4 (very valid).

Data analysis to answer the question "How is the characteristic leaflet based on Bruner theory on SPLDV material?" divided into two. First, calculate the percentage score scoring of the three validators using (1).(Riduwan, 2010).

$$p = \frac{f}{N} \; x \; 100\% \tag{1}$$

Description:

p = Percentage of final value

f = Score Accrual

N = Maximum Score

Furthermore, the percentage of final value gained compared to the criteria of the validity qualification and in table 2 (Riduwan, 2010).

Table 2. Criteria of Validity Qualification

Persentase	Qualification
$80\% < p \leq 100\%$	Very Valid
$60\% < p \leq 80\%$	Valid
$40\% < p \leq 60\%$	Fairly Valid
$20\% < p \leq 40\%$	Less Valid
$0\% \leq p \leq 20\%$	Invalid

Secondly, perfecting the Bruner theory-based leaflet specification on the SPLDV material refers to the third suggestion and comment validator. Based on the leaflet specification, further describe the characteristics of the leaflet. The procedure of this study can be described in Diagram 1.
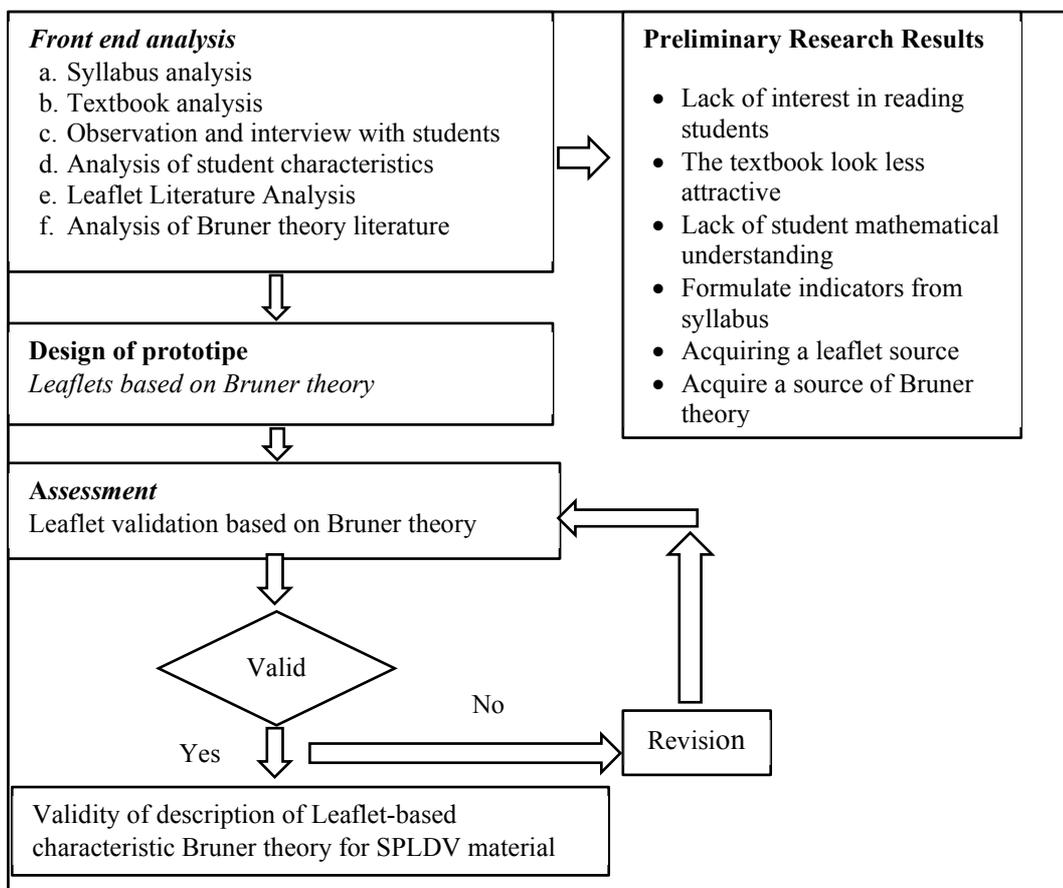

Diagram 1. A Bruner theory based Leaflet development procedure for SPLDV materials

RESULTS AND DISCUSSION

This study resulted in Bruner's theory-based leaflets for valid two-variable linear equations system (SPLDV) material. The development of this leaflet passes the preliminary research stage, prototype design and assessment. The following described the results of every development stage that has been performed.

The stage of preliminary research conducted resulted in potential and problems underlying the importance of the development of leaflets. Potential and problems are derived from the analysis availability learning resources, student

characteristics and learning observation results. First, the analysis results of the availability and quality of learning resources is (1) learning resources that are used only one based on curriculum of 2013 for junior high school revision version, (2) There are still questions about contextual books that are less familiar to students, (3) found some problems or problems that often eliminates the steps to find the iconic concept or stage. Although the iconic stage is a deciding for students to find a concept, and (4) There are inaccuracies in the writing of equations in alternative answers in the book of athematics students on first grade and first semester page 215 (As'ari dkk., 2017).

The student's characteristic analysis results are: (1) Students have less interest in reading, especially textbooks, (2) academic skills of second grade students are heterogeneous, (3) have a different learning style, there are kinaesthetic, audio, visual, and audio-visual, (4) students' interest and motivation to learn are less about mathematics learning. The results of mathematics learning observation were found that when the teacher explained the concept of mathematics and worked on examples of questions, only a few students could understand it. However, their understanding has not been well arranged. This can be proved when the students are given the practice of different forms from what the teacher explained. Students feel confused and do not know what steps they should use to solve the problem.

The weaknesses identified from the available learning resources and students' characteristics require that teachers need to innovate in developing teaching materials as a source book companion to fulfill the learning process standards (Permendikbud No. 22 in 2016). If the source book has questions or contextual issues that are unfamiliar to students, it would be difficult for students to understand the problem of having no direct experience (Pusvyta, 2019). The presentation of learning resources must relate to the level of cognitive development of students ranging from the level of sensory representation (enactive), Concerete representation (iconic) and the degree of abstract representation or symbolic (Dalyono, 2009). Therefore, the material presentation in the source book needs to pay attention to every stage of Bruner's theory of the enactive, iconic and symbolic

stage. In the event of a leap from an active stage to a symbolic stage, it will make students difficult to understand the concept (Isrok'atun & Amelia, 2018).

In the preliminary research phase, researchers have also reviewed the junior high school mathematics learning curriculum and acquired the basic competency of SPLDV. In addition, conducting literary reviews of several books, teaching material guidelines according to BSNP and journals that are used as reference for obtaining format, knowing the size of the appropriate leaflets, knowing how to prepare the material, knowing how to place the examples and exercises, and characteristic leaflets. From the literature review is also obtained explanation of each stage of Bruner theory and its implementation.

The design phase of the Propotype performed resulted in a leaflet specification based on Bruner's theory. These specifications are based on the results of preliminary research. Here are the leaflet-based specifications of Bruner theory for SPLDV materials that have been developed. Researchers developed five focus on leaflets.

1. Leaflet contains two variables Linear equation system material for class VIII odd semester.
2. Leaflets made alternating back.
3. Leaflet shaped sheet of paper that has two sides and consists of 3 folds, then each upper corner of the fold is given the page number.
4. Leaflet contains unique images, interesting colors, and a nice form of writing.
5. Language is easy to understand and communicative.

Leaflets consist of the following components:

a. Leaflet title adjusted to the indicator that will be discussed.
b. Content standards: Core competencies, basic competencies, and learning indicators.
c. Material drafted in Bruner theory
   1) The enactive stage contains the definition of a problem. Students are led to identify the problem given, and represent the problem through a picture and sentence.

      2) The iconic stage contains a series of visual images that direct students to a whole concept. Students are led to be able to represent images that are in the active stage into a mathematical sentence.

      3) Symbolic stage, students are expected to be able to define the picture, and the mathematical sentence becomes a whole symbol that corresponds to the language and logic of each of them.

d. Examples of questions contain one contextual problem and completion.

e. The motivation to learn contains a motivational sentence quoted from famous figures.

f. The practice of 2 or 3 questions measuring the ability to understand the mathematical concept of students.

g. The assessment results in the value that the student gained after working on the exercise.

The next phase after the Bruner theory-based leaflets was designed was judgment. The validation result of three validators is presented in table 3.

Table 3. Leaflet-based validation results for Bruner theory

No	Aspect	Validator			Total	Max	%	Category
		1	2	3				
1	Content Eligibility	68	57	71	196	228	85,96	Very Valid
2	Construction Eligibility	55	45	54	154	180	85,56	Very Valid
3	Graphic Eligibility	93	75	95	263	300	87,67	VeryValid
4	Language Eligibility	46	36	45	127	144	88,19	Very Valid
Total		262	213	265	740	852	86,84	Very Valid

Table 3 shows the validation results of a leaflet based on the Bruner theory for each aspect of which it is multiplied by 85%-89%. The overall leaflet based on this bruner theory is relatively valid with an average percentage of 86.84%. Based on the assessment, this study resulted in Bruner's theory based leaflets that meet the quality of eligibility according to BSNP standards (BNSP, 2013). This means that this leaflet can be viewed as a product that can solve the problem of this research, so that the objective of mathematics learning can be achieved.

Although the validation results show very valid results, the leaflet based on Bruner's theory will need to be corrected according to the third suggestion validator. The enhanced section is presented in table 4.

Table 4. Leaflet based on Bruner theory components for SPLDV materials to be repaired in accordance with the third suggestion Validator

Improvements made
1. Improvement of the rupiah nominal in the examples of questions and
2. Change the editorial question from "which SPLDV states the issue" becomes "which mathematical model that corresponds to the conditions of the above conditions"
3. Improvement of front-word and person name
4. Adding variable definitions, graphs, substitutions and elimaination on leaflets

The final outcome of the development phase in this study was produced by Bruner's theory-based leaflet for the highly valid SPLDV material. The characteristics of the leaflets are presented in table 5.

Table 5. The characteristics of the Leaflet based on Bruner theory for Validity of SPLDV material

Category	Characteristics
Validity	1. In accordance with the purpose of learning especially for SPLDV material.
	2. According to the needs and characteristics of junior high students.
	3. The composition of the material is burst.
	4. It contains unique images, interesting colors, and a nice form of writing.
	5. Presentation of material according to the stage of Bruner theory.
	a) The active stage contains the definition of a problem. Students are led to identify the problem given, and represent the problem through a picture and sentence.
	b) The iconic stage contains a series of visual images that lead students to a whole concept. Students are led to be

Category	Characteristics
	able to represent images that are in the active stage into a mathematical sentence.
	c) The symbolic stage, students are expected to be able to define the picture, and the mathematical sentence becomes a whole symbol that corresponds to the language and logic of each of them.
	6. In accordance with students' level of understanding.
	7. Based on real student experience.
	8. Contains motivational sentences quoted from famous figures.

This research findings in line with the findings of previous researchers (Safitri, 2019; Sari, 2019; Winarso & Yuliyanti, 2017) The resulting leaflet based on the valid Bruner theory and leaflets will lead to the passionate reading and learning of students. With unique images, interesting colors, and a good form of writing on leaflets, the students are interested to read them (Winarso & Yuliyanti, 2017). Reinforced again with a contextual problem that is quite familiar to students. The difference in research findings with previous research is that the research presented the characteristic of a valid Bruner theory based leaflet. This characteristic facilitates mathematics teachers in developing products and implementing Bruner's theory-based learning for semi-abstract and abstract material. The results of this research still leave the job for the next researcher to test the practicality and effectiveness of leaflet based on Bruner theory for SPLDV material to junior high school students in West Sumatera province.

CONCLUSION

This research has developed the Bruner theory-based leaflet for SPLDV material. The validator rating indicates that the leaflet is very valid and can be used for learning SPLDV using Bruner's theoretical approach. The characteristic of Bruner's theory-based leaflets for valid SPLDV material is in accordance with SPLDV's learning objectives, the presentation of the rled material, suitable for students who have a low interest in reading and understanding, based on the

students' real experience, containing unique images, interesting colors, and a good form of writing, containing motivational sentences quoted from famous figures. In addition, the presentation of leaflet material follows Bruner's theory of learning, which leads students to represent the problems identified, to create mathematical sentences from the results of the problem representation, and to make definitions of mathematical representations and sentences both verbally and symbolically. This leaflet can be used as an alternative to solve incomprehension concept of SPLDV experienced by junior high school students. The implications of this research were the need to implement leaflets in SPLDV learning and to develop leaflets based on Bruner's theories for other mathematical topics in order to understand the students ' mathematical concepts to be comprehensive.

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