Mathematics Teaching Instrument Using Discovery Learning Model For Social Arithmetic Topic of Junior High School

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ABSTRACT

This research was done based on the limited availability of teaching instrument for mathematic class as part of teacher preparation on the implementation of National Curriculum 2013. This research aims to develop the mathematics teaching instruments which includes Lesson Plan (LP) and Student Worksheet (SW). Those instruments were developed based on discovery learning steps for teaching social arithmetic at Junior High School. The development research procedure is carried out with reference to the 4-D model developed by Thiagarajan which is done through the stage of define, design, develop and disseminate.Teaching instrumentswere validated by four validators and revised based on the suggestion of the validators. Researcher did two tested that are small group tested and large group tested. Researcher did the small tested for 10 students of SMPN 13 Pekanbaru to determine the validity of SW. Researcher also did the large group tested to 38 students of VII.10 SMPN 13 Pekanbaru for applying the LP and SW and getting respond from students. Based on data analysis of validator and students' response it can be concludedthat the LP for social arithmetic is valid with score is 91.97% and the SW is very valid with the score is 89.40%. On Practicality aspects, SW had given score 95.70 % by student. Based on above score this teaching instrument is recommended to be used by the teacher in teaching topic social arithmetic for Junior High Students.

Key word :*Development Research, Lesson Plan, Student Worksheet, Discovery Learning.*

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Introduction

Every teacher should be able to create a good learning atmosphere. Besides, the teacher must also know the goals of learning and they which to achieve those goals of learning. According to Made Wena (2011), the learning process influence the learning outcomes of students. The learning process can work well if the teacher is able to develop a lesson plan and organize the learning process in appropriate with the plan. Therefore, a good lesson plan is importantto achieve the purpose of learning.

Learning planning is known as lesson plan. M. Fadlillah (2014) states that lesson plan is a form of learning planning that will be implementedby teacher in learning activities. Teachers should be able to develop a good lesson plan and organize it in the learning process. According to Ali Hamzah and Muslisrarini (2014), lesson plan is prepared by teachers aimed at determining expected learning conditions, learning methods to be undertaken and learning outcomes to be achieved by students. Preparation of lesson

plan aims to design the learning experience of students to achieve learning objectives.

The implementation of lesson plan can not be separated from the learning activities in the classroom. Learning activities should encourage students to be passionate, increase their interests, creativity, innovation and independence. Learning activities are changed from being notified to find out. Students will find concepts and the teacher be a facilitator. In preparing the learning activities, teachers can use a variety of learning models that can improve students' liveliness in finding concepts. One of the instructional models suggested by Permendikbud Number 22 of 2016 on Standard Process of Primary and Secondary Education is discovery learning. According to M. Hosnan (2014), discovery learning is a model to develop students' way of learning actively by finding their own, self-investigating, then the results obtained will be faithful and durable in memory, will not be easily forgotten.

Discovery learning is a learning activity that will require students to conduct an investigation. To conduct an investigation, good guidance is needed so that the investigation can proceed smoothly and students can construct knowledge through the investigation. One form of guidance that can be used is the student worksheet. Trianto (2010) defines that STUDENT'S WORKSHEET is a student's guide that is used to conduct investigation and problem-solving activities. Teachers can develop t and use the STUDENT'S WORKSHEET in learning.

One of the mathematical material that can be taught by using discovery larning model is social arithmetic material. Social arithmetic is found in the daily lives of students. Through learning discovery learning, students will be invited to find concepts related to sale and purchase, discount, tax, interest, and gross, net and tara. Besides, students are expected to apply knowledge about social arithmetic in their own life.

Based on the results of interviews with some teachers of mathematics, it is found that teachers have difficulty in arranging learning activities. Besides, teachers also have difficulty in compiling assessment of learning outcomes. Teacher also said that there is no example of lesson plan that can be used by teachers to be used as guidance in preparing the lesson plan based on Curriculum 2013. According to the observations of Daryanto and Aris Dwicahyono (2014), the lesson plan compiled by teachers only contains non-operational steps. Lesson plan is not prepared completely. In fact, lesson plan is only used as a document and administrative requirements alone without being applied in the learning process.

The learning process that teachers often do in the classroom is to explain the subject matter. The teacher explains the material by giving formulas and sample questions. Teachers do not explain to students the origin of the given formula so that students seem to memorize only the formula without knowing where the formula is obtained.

Based on the problem above, the researcher develops the 2013 curriculum lesson plan which can be used as the guideline for the teacher in preparing the lesson plan. Then, researchers are also developing student's worksheet that can be used to investigate and construct knowledge about social arithmetic that includes sale, purchase, discount, tax, single, gross, net and tare. Researchers want to submit a research title, the tittle is mathematics teaching instrument using discovery learning model for social arithmetic topic of junior high school.

Methodology

In this research, the development research model is 4D model. The 4D research and development model was developed by Thiagarajan. The 4D model includes define activity, design, develop (development), and disseminate, (Endang Mulyatinigsih, 2011).

Define activities are performed to set and define development requirements. According to Thiagarajan (in Endang Mulyatiningsih, 2011), define activities are carried out through five steps such as initial analysis, learner analysis, task analysis, concept analysis, and goal specification. Design activities conducted to make learning instruments in accordance with the results of the analysis has been done. At this step, researchers have had initial products of six lessojn plans and six student's worksheets. After develop activities are done, through the validation stage of the learning instrument by the validator and the test to find out the assessment of the respondents. Learning intrument that have been validated are then revised before testing. Disseminate activities performed to see the effectiveness of products created. In this study, the steps will be done until the step of develop due to time and cost constraints. This research is just to see if the learning instrument of mathematics that has been developed is valid and can be used

Learning instruments that have been developed and then tested. Tested were conducted twice issmall-group-tested and large-group-tested. The subjects of small-group-tested in this study were 10 students class VII SMP Negeri 13 Pekanbaru. The subjects of large-group-tested in this study were 38 students of class VII.10 SMP Negeri 13 Pekanbaru.

The data collection in this research is done through validation sheet filled by validator and students response questionnaire filled by students. The validation sheet is used determine the validator's assessment of the learning instrument that has been developed. The student response questionnaire is used todetermine the response the students to the student's worksheet that has been used.

The learning instrument validation sheet in the form of lesson plan and student's worksheet in this study were using Likert scale with the rating category which can be seen in Table 1 below

Table 1. Categories of Assessment Validation of Learning instrument

Category	Score
Very inappropriate	1
inappropriate	2
Appropriate	3
Very appropriate	4

(*Source*: Asyti Febliza and Zul Afdal, 2015)

The student's worksheetreadout rating sheet uses a Likert scale. The assessment criteria on student's worksheet by students can be seen in Table 2 below.

Table 2. Category Assessment of Student's Worksheet through Questionnaire Response Students

Kategori	Skor
Very disagree	1
Disagree	2
Agree	3
Very agree	4

(*Source* : Asyti Febliza dan Zul Afdal, 2015)

The result of validation that was given by validator can be calculated by using the formula below.

$$V_a = \frac{Tsa}{Tsh} \times 100\%$$

Information :

V_a= validation score

Tsa = total empirical score from experts

Tsh =total max expected

To find out the final score of the validators, can use the formula

$$\overline{v_a} = \frac{\sum_{i=1}^{n} V_{a_i}}{n}$$

Information :

n =number of validators

V_{a_i} = the validity score of each validator

$\overline{v_a}$ =average score validation from experts

The validation criteria based on the validation results can be seen in Table 3 below

Table 3. Learning Instrument ValidationCriteria

Level of Achievement	Criteria of Validation
85,01% - 100,00%	Very valid.
70,01% - 85,00%	Valid
50,01% - 70,00%	Less valid
01,00% - 50,00%	Not valid

(*Source :* Sa'dun Akbar, 2013)

To determine the student's worksheet rating and readability of the students, the student's worksheet response test results can use the following formula.

$$V_p = \frac{Tsp}{Tsh} \times 100\%$$

Information :

V_p = score of respondents

Tsp = total empirical score from respondents

Tsh = total max expected

To know the final score of the users, can use the formula

$$\overline{v_p} = \frac{\sum_{i=1}^{n} V_{p_i}}{n}$$

Information :

n = number of respondents

$\overline{v_p}$ =average response score fromrespondents

V_{p_i} = the response score of each respondent

The criteria of the practicality level of learning instruments from users can be seen in Table 4 below

Table 4. Criteria Level of Practicality

Level of Achievement	Criteria of Achievement
85,01% - 100,00%	Very practice.
70,01% - 85,00%	Practice
50,01% - 70,00%	Less practice
01,00% - 50,00%	Not practice

(*Source :* Sa'dun Akbar, 2013).

According to Sa'dun Akbar (2013), learning instruments can be used if the percentage of validation and readability rate is more than 70%.

Result and Discussion

The researcher analyzes the problems related to the Curriculum 2013. Problem analysis is focused on the learning instruments Curriculum 2103. The problems found are the lack of mathematics-based learning instruments Curriculum 2013 and teachers find difficulties in designing lesson the suggested Permendikbud number 22 of 2016 on Basic Education Process Standards and Medium learning activities are suggested. Besides, problems were found related to teacher books and student books. The teacher's books and student's books provided by the government have not been suitable with the characteristics of students and regions. For that, teachers need to prepare a resource that is appropriate to the characteristics of students. Teaching materials that teachers should be able to improve the livelihood of students in finding knowledge. Teaching materials that can be prepared by the teacher is the student's worksheet.Learning using student's worksheet is expected to invite students to perform various activities to find mathematical concepts. At school, students have used the worksheet that the school has provided as one of the study guides. However, the worksheet provided contains only a summary of the material and practice questions. According to Trianto (2010), the

learner worksheet is a guide that students use to conduct investigations and problem solving. The existing worksheet does not provide facilities for students to conduct investigations and troubleshooting.

Based on the analysisabove, to create an expected learning atmosphere in the Curriculum 2013, it is necessary that learning instruments can invite students to conduct inquiry in the form of lesson plan and student's worksheet based on discovery learning which is based mainly on social arithmetic materials for junior high school.

Target of this research is class VII student. Researchers analyze the characteristics of students that include the level of intelligence and study habits. The subject of this research is 38 students of class VII.10 SMP Negeri 13 Pekanbaru. The results of the analysis obtained is that students who are aged over 11 years. Students of class VII.10. Student learning habit of class VII.10 have some variety. Some students can understand the material only by reading the book and the other students can understand the material if it is explained by all teachers.

Students over the age of 11 have entered the formal operational stage. According to Piaget (in Jeanne Ellis Ormrod, 2009), children entering the formal operational stage have reasoning abstract ideas, are able to formulate hypotheses and test hypotheses, and are capable of separating and controlling variables. Based on the developmentsabove, the students of class VII can already be taught by applying the model of discovery learning.

Researchers analyze competence through Permendikbud number 24 of 2016 on Core Competencies and Basic Competencies. The Core Competencies used in developing mathematics learning instruments are Core Competencies-1, Core Competencies -2, Core Competencies-3 and Core Competencies-4 regarding spiritual, social, knowledge and skills attitudes. Researchers develop learning instruments for Basic Competencies 3.9 which recognizes and analyzes various situations related to social arithmetic (sales, purchases, discounts, gains, losses, single interest, percentage, gross, net and tare) and Basic Competence 4.9 is resolves issues related to social arithmetic (sales, purchases, deductions, gains, losses, single interest, percentage, gross, net and tare).

Researchers designed discovery learning based learning instruments for social arithmetic materials. The design of the next learning device is arranged according to the format. At this step, researchers have had prototypes for six lesson plans and student's worksheets. The prototype lesson plans and student's worksheets are then validated by four validators. Researchers analyzed the validation results of lesson plans and student's worksheets.

The researcher analyzed the validation result of lesson plan from validator. The average of lesson plan validation results can be seen in Table 5 below.

Table 5. Result of 6 Lesson Plan

Assesment Indicator	Average
Completeness of lesson plan identity.	100.00
Completeness of lesson plan component.	100.00
Clarity of core comparisses and basic comparisses	100.00
Clarity of achievement indicators	96.18
Conformity of learning objectives with indicators	95.83
The suitability of the subject matter	89.33
The suitability of learning activities with a scientific approach	89.93
Conformity of learning activities with discovery learning model	82.29
Compatibility of tools, media, and	79.51

learning resources	
Conformity assessment of learning outcomes	85.07
Average of percentage	91.97
Criterion	Very valid

Based on Table 5 it can be seen that six lesson plans that have been developed have a value of 91.97% with criteria is very valid. However, there are some aspects that need to be improved on learning media, learning activities, and assessment of learning outcomes. According to the validator, learning media used not only student's worksheet but also can use other media such as goods related to the material and also can use electronic tools like computer as a supporter of learning. Learning activities are prepared by applying the discovery learning model. According to the validator, the step of stimulation given to students should use a simple language and in accordance with the thinking of students. In addition, the stimulation should be in accordance with the learning objectives. Validators also suggest that assessment of learning outcomes instrument to the learning objectives

The researcher analyzed the student's worksheet validation result from the validator. The average student's worksheet validation results can be seen in Table 6 below.

Table 6. Validation Result of 6 Students's Worksheet

Assesment Indicator	Average
Conformity of learning materials	91.25
Presentation of learning materials	85.35
Student's worksheet compatibility with Discovery Learning steps	86.46
Student's worksheet compatibility with the level of ability of students	85.42
The accuracy of word selection	85.07
Component SW	98.75
Posts used in SW	93.23
The images presented in student's worksheet	91.67
Display student's worksheet	87.50
Average percentage	89.40
Criteria	Very valid

Based on the above table it can be seen that the six student's worksheets that have been developed get the value of 89.40% with very valid criteria. Validator provides some suggestions for student's worksheet improvement. According to the validator, stimulation in student's worksheets adjusted to the characteristics and level of thinking of students. Use a simple language and note the order of the sentence to be easily understood students. The validator also suggests looking at the size of the columns used as a facility for students to write down answers.

The next step is to test for student's worksheet. Tested are conducted through two stages issmall-group-tested and large-grouptested. Small-group-tested were conducted to 10 students of class VII of SMP Negeri 13 Pekanbaru. The results of small-group-tested for six student's worksheets can be seen in Table 7 below.

Table 7. Average small-group-tested of six Student's Worksheet

Indicator	Percentage
Material description	93.33
Mastery of matter	94.58
Student's worksheet presentation	93.75
Conformity of the discussion used	92.71
The suitability of the image used	90.92
Color composition	94.17
Adequate space for students	94.17
Clear clarity and purpose	95.29
Conformity problems with real life	93.33
Steps of inquiry	95.42
Curiosity	95.42
Independent	95.88
Motivation	95.25

Average	94.17
Criteria	Very practice

Based on Table 7 it can be seen that six student's worksheets that have been developed score 94.17% with very practical criteria. The questionnaire results for each indicator is over 90%. It showed that six student's worksheets that have been developed can be used by students who have heterogeneous capabilities. Based on the results of interview researchers to students, they said that they understand learning by using student's worksheets that has been developed. The student's worksheets presentation is quite clear, so that students can understand the material well but it needs to be improved a few sentences are difficult to understand. During Student's Worksheet-1 and Student's Worksheet-2 trials, some students ask how to design problem solving as this is new for them. Researchers guide students to design problem solving. For Student's Worksheet-3 to Student's Worksheet-6, students can already design problem solving but still be mentored by the teacher.

Researchers improve student's worksheetaccording to the advice of the students. Researchers conducted large-group-tested on 38 students class of VII.10 of SMP Negeri 13 Pekanbaru consisting of 10 students who have followed a small-group-tested and 28 students who have not followed a small-group-tested. The results of large-group-tested can be seen in Table 8 below.

Table 8. Results of large-group-tested Student's Worksheet-1

Indicator	Percentage
Material description	96.05
Mastery of matter	94.08
Student's worksheet presentation	95.39
Conformity of language used	93.42
The suitability of the image used	97.70
Color composition	96.05
Suitability of free space for students	96.05
Clear clarity and purpose	96.05
Conformity problems with real life	96.71
Steps of inquiry	97.37
Curiosity	94.74
Independent	95.07
Motivation	95.39
Average	95.70
Criteria	Very practice

Large-group-tested were conducted to determine the use of lesson plans and student's worksheet in the classroom. At this step, the researcher acts as a teacher and uses Lesson Plan-1 as a guide in implementing the learning process in the classroom. The teacher provides a simple explanation related to buying and selling that aims to stimulate the thinking of students. The teacher forms eight groups consisting of 4-5 students and gives Student's Worksheet-1 to each students. Then the teacher asks each student to discuss with their group to study the sudent's worksheet given. Then the teacher guides each group to learn to use student's worksheet. After conducting trials, the teacheras also a researcher gives a response questionnaire to each student to knowthe response students after learning to use student's worksheet.

Based on Table 8 it can be seen that the results of large-group-tested for Student's Worksheet-1 obtained a value of 95.70% with very practical criteria. Each indicator scores above 90%. At the time of large-group-tested, researchers found difficulty in applying discovery learning model. Discovery learning model is a new learning model for students of class VII.10 SMP Negeri 13 Pekanbaru. Difficulties found when designing a solution and formulating a hypothesis. Students do not know how to design problem solving. Researchers provide a simple illustration for designing a solution. From the illustration, students have been able to design a solution

and formulate the hypothesis but the researcher still guided the students

Based on the results of interviews of researchers to the three students, they said that learning by discussion method is very interesting. Through group discussions, they could share their opinions in solving problems. Thus, student's worksheet is very interesting and stimulate students to think and increase their curiosity so that students are motivated to solve math problems presented in the student's worksheet.

Based on the results of questionnaire responses and interviews from students can be concluded that learning instruments in the form of student's worksheetfulfilled the requirements of practice and can be used for all students who have a heterogeneous ability level. Learning instruments such as lesson plans and student's worksheet based discovery learning that have been developed can be used to study social arithmetic materials for junior high school.

Conclusion

Research development is done is the development of learning instruments mathematics. Based on the validation and experiments that have been done, it can be concluded that learning instruments in the form of lesson plans and student's worksheets based discovery learning for social arithmetic materials for junior high school is valid and fullfied the practical requirements for use by students of class VII. Learning instruments in the form of lesson plan for social arithmetic material are very clear. Learning activities are arranged in sequence. Assessment of learning outcomes in developed lesson plan is complemented by practical scoring instruments and guidelines. Learning instruments in the form of student's worksheet can increase the student's activity to conduct investigation and discover new knowledge. Besides, the developed student's worksheet has completed the instructions for students to investigate. Thus, learning instruments such as lesson plans and student's worksheets based discovery learning for social arithmetic materials for junior high school can be used to study social arithmetic.

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