DEVELOPING GEOMETRY LEARNING MATERIALS USING GUIDED INDUCTIVE INQUIRY MODEL FOR GRADE VIII STUDENTS OF JUNIOR HIGH SCHOOL

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Abstract

This study was aimed at developing and describing appropriate geometry learning materials in the forms of lesson plans and student worksheets using guided inductive inquiry model for grade VIII students of Junior High School. It is classified as Research and Development study based on 4D model which includes four stages that are define, design, development, and dissemination. The results of materials assessment show that the materials are considered appropriate and meet the minimum criteria of good lesson plans and student worksheets. From the 5 scale, the mean score of lesson plans is 4.62 and considered "very good". Meanwhile, the mean score of student worksheets is 4.48 and considered "very good". Both lesson plans and student worksheets were assessed by two experts and one mathematics teacher. The results of questionnaires from the students and the teacher towards the learning materials show that the learning materials is considered practical with score of 4.25 from the 5 scale, which mean "very good". The results of learning observation questionnaires show that the learning materials is considered "very good", in which the average percentage is 93.3%. On the other hand, the results of students' achievement test show that the learning materials is considered effective as 87.5% of students' score passed the minimum criteria of good mastery.

Keywords: learning materials, guided inductive inquiry, geometry

INTRODUCTION

Slavin (2011: 177) says that a learning is a changeover of someone inside which is caused by experience. A learning could be done effectively and efficiently if it is well-planned, valued, and controlled. Based on School-Based Curriculum (*Permendiknas Nomor 41 Tahun 2007* about Process Standard) the learning plans include the sillabus and the lesson plans. The lesson plans are written in accordance to the sillabus, in which they include the identitiy, indicators, learning objectives, learning materials, learning methods, steps of learning, learning sources, and the assessments. The lesson plans are designed by the teacher as the guidelines to conduct the learning. A good learning process should have been able to facilitate the students to be active in the process. Meanwhile, not all of teachers has been capable to design a good lesson plan that could motivate the students to learn, because they are lack of learning methods

variation and learning sources. Therefore, the learning model and the learning sources that could motivate the students to actively learn are highly needed.

Based on Siti Rochana (2015), one of learning methods that could be used to give more experiences and motivations to the students is inquiry method. Inquiry is a learning method that facilitate students learn actively by inquiry activities. Based on Orlich et al (2007:296), it is mentioned that inquiry methods require the learner to develop various processes associated with inquiry. Empirically, inquiry makes the students able to acquire knowledges through observation or exploration. One of inquiry models that is guided by the teacher is called guided inquiry. Guided inductive inquiry model is one of inquiry learning models that is designed based on inductive reasoning. One of its characteristics is to make a class as a learning laboratory. Thus, students could generalized the specific events,

patterns, or problems which are provided by the teacher trough inquiry activities and pattern exploration. Orlich et al (2007: 300) say that the steps for guided inductive inquiry learning model are to (1) decide on the generalization students should make during a particular unit of study, (2) organize the learning activities and materials in a manner that exposes the strands or parts of the generalization to students, (3) ask the students to write a summary of the content that will form the basic of the generalization, (4) ask the students to identify patters of events, objects, or other data in the content, (5) ask the students to summarize these patterns in one sentence, (6) ask the students to offer proof that their statement is, in fact, a generalization by applying it to other events, objects, or data. It is expected that the lesson plan designed using guided inductive inquiry model is able to facilitate the students to be active in doing inquiry activities and patterns exploration from specific events which are provided by the teacher.

Other components in lesson plan that should be included to the learning process is variations of learning sources. Based on *BSNP* (2007:25), learning sources is all things that contain informations, that is developed or could be useful to give experience and or that makethe learning possible. One form of learning sources that could be used to support the learning is student worksheet. It contains the steps of instruction to guide the students to understand the concept and finishing a task. The purposes of student worksheet proposed by *Depdiknas* (2008:36) are to (1) facilitate the students build the concept, (2) facilitate the students apply the concept that has been inquired, (3) guide the learning through inquiry activities, (4) strengthen the student ability.

Hendro Darmodjo and Jenny R.E. Kaligis (1992:42) say that a good student worksheet is the one that meet didactic, constructive, and technical requirement. Besides, a good student worksheet is designed by referring to components of student worksheet evaluation proposed by *Depdiknas* (2008: 28). They include content appropriateness, language appropriateness, presentation appropriateness, and graphic appropriateness. Therefore, it is highly needed to develop student worksheet using guided inductive inquiry model that meet content appropriateness, presentation appropriateness, didactic requirement, constructive requirement (language appropriateness), and technical requirement (graphic appropriateness) that could motivate the students to be active learners.

One of the subjects which is learned at school is mathematics. The scope of this subject intended for Junior High School students include some aspects, namely (1) number, (2) algebra, (3) geometry and measurement, and (4) statistics and probability. Based on the data from Kemendikbud released in 2015, the results of geometry final examination in 2014/2015 got the lowest percentage as described in the Table 1.

Table 1. The Percentage of Mathematics Final Examination Results in 2014/2015

No	The Tested Capability	National
1	Number	60,64
2	Algebra	57,28
3	Geometry and Measurement	52,04
4	Statistics and Probability	60,78

Besides, geometry is one of content domain in international survey Trends in International Mathematics and Science Study (TIMSS). Based on TIMSS results in 2011, the average score of student's achievement in Indonesia is 397. It was far from international average score that is 500.

Based on the description above, it was concluded that the research was focused at developing appropriate geometry learning materials consisting of lesson plans and student worksheets using guided inductive inquiry model for grade VIII students of Junior High School.

RESEARCH METHOD

This research is classified as Research and Development (R&D) research study, in which the product is geometry learning materials in the forms of lesson plans and student worksheets using guided inductive inquiry model for grade VIII students of Junior High School. It was

conducted on April 2nd – 30th, 2016 in SMP Negeri 3 Godean that is located at Sidoarum, Godean, Sleman, Yogyakarta. There were 32 students of class VIII A in the academic year of 2015/2016 involved in this research.

Study Design and Development

The procedure in conducting the research is 4D model proposed by Endang Mulyatiningsih (2012: 195-199). The stages are define, design, development, and dissemination.

First, the define stage in the development of learning materials context consist of four activities they are curriculum analysis, the characteristics of student analysis, material analysis, and formulate objectives.

Second, the design is the stage where researcher designs the initial draft of lesson plans and student worksheets according to the curriculum and material analysis. At this stage the researcher also develop the instruments that will be used to assess the developed learning materials. Instruments was designed in accordance to the principals proposed by Nieveen (1999:126-127). He state that a good product should meet three aspects of quality, they are (1) validity, (2) practicability, and (3) effectiveness. Furthermore, the instruments that have been designed will be validated to obtain a valid assessment of instruments.

Third, the development is the stage where researcher try out the learning materials. The development of lesson plans and student worksheets conducted in accordance with the initial design to be validated by two experts and one mathematics teacher. Validation results are analyzed and acted upon by the revision of learning materials according to the suggestions and the comments from validators. The learning materials which is has been revised, will be tried out. The try out of this research conducted for grade VIII students of Junior High School. Next, the results of learning materials' try out were used as the guidelines for revision. Therefore, the developed learning materials truly appropriate for grade VIII students of Junior High School.

At this stage also conducted the achievement test to measure the effectiveness of learning materials.

The last stage is dissemination. It was conducted a small learning materials socialization to the teacher and the students at this stage. The distribution was conducted to get the responses towards the developed learning materials. If the responses from the teacher and the students are considered "good", then the learning materials will be printed in a large amount to publish, so that they could be used by the others.

Data, Intrumens, and Data Collection Techniques

The data used in this research were the qualitative and quantitative data. The qualitative data were in the forms of comments and suggestions by the experts and mathematics teacher that were obtained on the validation process and they were used as the guidelines for revision. The quantitative data were obtained from the results of assessment questionnaire by the experts and mathematics teacher, the results of responses questionnaire by the teacher and students towards the learning materials, the results of learning observation questionnaire by the observer, and the results of achievement test by the students.

Data Analysis Technique

The qualitative data were analyzed through qualitative descriptive and the results were used as the guidelines of learning materials' revision. Otherwise, the quantitative data analysis includes the analysis of validity, practicability, and data effectiveness. The instrument used to analyze the validity of the assessment of lesson plans and student worksheets was descriptive analysis with the following steps: (1) change the qualitative data into quantitative data, (2) calculate the average of scores obtained, (3) convert the average value obtained into qualitative data. Based on these data, the conversion guidelines are shown in the Table 2 according to Eko Putro Widyoko S (2012: 112-112).

Table 2. Conversion Criteria of Quantitative Data to Qualitative Data

No.	Average Score $(\bar{x})$	Criteria
1	$4,2 < \bar{x} \leq 5,0$	Very Good
2	$3,4 < \bar{x} \leq 4,2$	Good
3	$2,6 < \bar{x} \leq 3,4$	Fair
4	$1,8 < \bar{x} \leq 2,6$	Poor
5	$1,0 < \bar{x} \leq 1,8$	Very Poor

Not only the questionnaire responses from the students and the teacher used to analyze the practicability, but also the learning observation questionnaire. Practicability analysis of the questionnaire responses from the students and the teacher performed the same ways with the validity analysis above. Otherwise, the learning observation questionnaire analysis described as follow: (1) calculate observer's answer, (2) convert the percentage of learning observation value obtained into qualitative data using this formula:

$$p = \frac{y}{n} \times 100\%.$$

Based on these data, the following conversion guidelines are shown in the Table 3 according to Yuni Yamasari (2010:4).

Table 3. Practicability Criteria of Learning Materials

No.	Percentage Interval	Criteria
1	$p \geq 85$	Very Good
2	$70 \leq p < 85$	Good
3	$50 \leq p < 70$	Poor
4	$p < 50$	Very Poor

The instrument used to analyze the effectiveness towards the learning materials is the achievement test. If the students' score is greater than or equal to the minimum criteria of good mastery (KKM), then they attain the expected competences or passed. According to *Permendiknas Nomor 20 Tahun 2007* about Education Assessment Standard, the minimum criteria of good mastery is a criteria of mastery learning (KKB) which is determined by the school. The minimum criteria of good mastery score used in this research is 75.

The assessment of effectiveness is analyzed by the following steps: (1) calculate achievements test score obtained by students, (2) calculate the number of the students who passed the minimum criteria of good mastery, (3) calculate the mastery learning percentage using this formula:

$$p = \frac{n_t}{n} \times 100\%,$$

(4) convert the mastery learning percentage based on students' academic competence criteria proposed by Eko Putro Widyoko S (2009:242) which is shown in the Table 4.

Table 4. Assessment Criteria of Academic Competence

No.	Mastery Learning Percentage	Criteria
1	$p > 80$	Very Good
2	$60 < p \leq 80$	Good
3	$40 < p \leq 60$	Fair
4	$20 < p \leq 40$	Poor
5	$p \leq 20$	Very Poor

RESULTS OF STUDY AND DISCUSSION

Based on the results of Research and Development that has been described, the development of the learning materials is compiled with 4D model - define, design, development, and dissemination- produced a geometry learning materials in the forms of lesson plans and student worksheets using guided inductive inquiry model for grade VIII students of Junior High School.

The learning materials using guided inductive inquiry model is a learning materials that is developed based on the learning steps of guided inductive inquiry model which was not only applied on the lesson plans at the steps of learning activities, but also on the features of student worksheets- namely title, what will you learn, hypotheses, activities, conclusion, and conclusion test.

The learning materials has been validated by two experts and one mathematics teacher of SMP Negeri 3 Godean. The results of the learning materials validity showed in Table 5 and Table 6.

Table 5. The Analysis of Lesson Plans Assessments

Assessment Aspects	$\bar{x}$	Criteria
Identity Clearness	5.00	Very Good
Identity Completeness	5.00	Very Good
Indicators and Learning Objectives	4.83	Very Good
Learning Material	4.44	Very Good
Learning Source, Media, and Model	4.33	Very Good
The Relevancy of Guided Inductive Inquiry Model	4.67	Very Good
Learning Assessment	4.67	Very Good
Mean	**4.62**	**Very Good**

Note: $\bar{x}$ is the average score.

Table 6. The Analysis of Student Worksheets Assessments

Assessment Aspects	$\bar{x}$	Criteria
Content Appropriateness	4.40	Very Good
Presentation Appropriateness	4.53	Very Good
Didactic Requirement	4.33	Very Good
Constructive Requirement	4.67	Very Good
Technical Requirement	4.57	Very Good
Mean	**4.48**	**Very Good**

Note: $\bar{x}$ is the average score.

The mean of the lesson plans assessments is considered "very good" with score 4.62 from 5 scale assessed by validity aspect. Based on this results, the developed lesson plans are appropriate with the components and principals of designing lesson plan proposed by *Permendiknas Nomor 41 Tahun 2007* about Process Standard. It was shown by Table 5, the relevancy of guided inductive inquiry model meets very good criteria with score 4.67 from 5 scale. This shows that learning activities placed the students to be active learner as relevant as Brown et al (2007:2).

The student worksheets assessments showed that the mean score was 4.48 from 5 scale, which is considered "very good" from validity aspect. Based on this results, the developed student worksheets meet the appropriateness of learning materials proposed by *Depdiknas* (2008: 28), they are content appropriateness, presentation appropriateness, language appropriateness and graphic appropriateness. Besides the developed student worksheets are considered "good" according to Hendro Darmodjo and Jenny R.E. Kaligis (1992:42) that meet didactic, constructive, and technical requirement. It was shown by Table 6, the highest assessment aspect score was constructive requirement with the average score 4.67 from 5 scale. Indeed, the developed student worksheets meet language appropriateness. It means that the student worksheets are appropriate with the development of students' cognitive.

The practicability of the developed learning materials not only measured by the questionnaire responses from the students and the teacher but also the learning observation questionnaire. The Table 7-11 below showed the analysis of those practicability instruments.

Table 7: The Analysis of Students' Questionnaire Responses towards The Student Worksheets

Assessment Aspects	$\bar{x}$	Criteria
Usability	4.14	Good
Easiness	4.11	Good
Score	**4.13**	**Good**

Note: $\bar{x}$ is the average score

Table 8. The Analysis of Teacher's Questionnaire Responses towards The Student Worksheets

Assessment Aspects	$\bar{x}$	Criteria
Usability	4.57	Very Good
Easiness	4.50	Very Good
Score	**4.54**	**Very Good**

Note: $\bar{x}$ is the average score

Table 9. The Analysis of Teacher's Questionnaire Responses towards The Lesson Plans

Assessment Aspects	$\bar{x}$	Criteria
Usability	4	Good
Easiness	4.2	Good
Score	**4.1**	**Good**

Note: $\bar{x}$ is the average score

Table 10. The Analysis of Students and Teacher Questionnaire Responses towards The Learning Materials

Respondent	$\bar{x}$	Criteria
Students (LKS)	4.13	Good
Teacher (LKS)	4.54	Very Good
Teacher (RPP)	4.1	Good
Final score	**4.25**	**Very Good**

Note: $\bar{x}$ is the average score

Table 11. The Analysis of Learning Observation Questionnaire

Learning Processes	p	Criteria
First Meeting	93.3%	Very Good
Second Meeting	93.3%	Very Good
Third Meeting	93.3%	Very Good
Fourth Meeting	93.3%	Very Good
Score	**93.3%**	**Very Good**

Note: p is the percentage of observation learning

Based on the results of achievement test which is limited conducted for 32 students Grade VIII at SMP Negeri 3 Godean using 2 from 3 lesson plans and 4 from 8 student worksheets, the students and the teacher told that the learning materials was easy and usable. The learning steps were easily presented for geometry learning. This helped the students to solve the problems. It was shown by Table 7, the score of easiness aspect scored 4.11 from 5 scale which is considered "good". This condition was appropriate with Ulfa Arisa Cahyani (2014: 51) whom state that practicability aspect criteria obtained from the results of easiness aspect by students' responses. Based on Table 8, the usability aspect scored 4.57 from 5 scale which is considered "very good". Therefore, according to the teacher, the student worksheets helped the students to master the geometry materials as well. Based on the teacher's responses towards the lesson plans which is shown in Table 9, show that the produced lesson plans could be easily use at the geometry learning. Finally, based on Table 10, the average percentage of learning observation attain 93.3% which is considered "very good". Over all the learning processes using guided inductive inquiry model run well, there was only one step could not be conducted because the limit

of time. In conclusion, the learning materials meet the practical criteria of practicability aspect.

The effectiveness of learning materials measured by the achievement test results. The Table 12 below describe the analysis of the achievement test.

Table 12. The Analysis of The Achievement Test Results

Note	The Achievement Test
Maximum Score	100
Minimum Score	66
The Sum of Passed Students	28
The Sum of Failed Students	4
P	**87.5%**

Note: p is the percentage of mastery learning

The percentage of mastery learning attain 87.5% which is considered "very good". The results show that the learning materials used at the learning process had attained the expected competences and effected the achievement test results. This results appropriate with the research of Yulia Sulistia (2010), shows that inductive approach effected the students' mathematical achievement results.

This succesful learning is caused by learning process using guided inductive inquiry model which facilitated the students to be actively learn trough inquiry and patterns elaboration activities of specific events provided by the teacher. This experiences guide the students to attain the competences at the end of the learning. Indeed, the developed learning materials meet the effective criteria from effectiveness aspect.

Based on the results of the study above, the developed learning materials are considered "good" from validity aspect, practicability aspect, and effectiveness aspect. This study results are relevant to the study of Siti Rochana (2015) that produced space geometry learning materials using guided inquiry model for Junior High School which are oriented to creative thinking and learning motivation in the forms of lesson plans and student worksheets that meet the valid, practical, and effective criteria. In conclusion, this study has produced geometry learning materials using guided inductive inquiry model for grade VIII students of Junior High School that

considered to be "good" assessed by validity, practicability, and effectiveness aspect.

CONCLUSION AND RECOMMENDATION

Conclusion

Based on the description on the research findings and discussion, it is concluded that the developed learning materials were considered appropriate. The geometry learning materials which include the lesson plans and student worksheets with guided inductive inquiry model for grade VIII students of Junior High School got the minimum criteria of good materials. From 5 scale, the results of lesson plan validation got the average score 4.62 and was considered "very good". Meanwhile, the results of student worksheets got the average score 4.48 and was categorized "very good". Thus, from the two results of validation, the geometry learning materials with guided inductive inquiry model could be used as the teacher guideline in the learning process.

The geometry learning materials which include the lesson plans and student worksheets using guided inductive inquiry model for grade VIII students of Junior High School has been tried out in SMP Negeri 3 Godean and it got the minimun criteria of good materials and considered practical as it explained in practicality aspects. Based on the practicability of lesson plans result from the teacher, they are considered "good" with score 4.1 from 5 scale. The mean score of the questionnaire responses from the teacher towards the student worksheets is 4.54 from 5 scale, which is considered "very good". Besides, the mean score of the questionnaire responses from the students towards the student worksheets is 4.13 from 5 scale, which is considered "good". Based on the results obtained, the learning equipments are considered "very good" with the final score is 4.25 from 5 scale. Meanwhile, the average percentage of learning observation is considered "very good", in which the average percentage is 93.3%.

The geometry learning materials in the forms of lesson plans and student worksheets using guided inductive inquiry model for grade VIII students of Junior High School that had been tried out in SMP Negeri 3 Godean meet the "good" criteria and considered effective as it

explained in effectiveness aspects. The percentage of students mastery learning is 87.5%.

Recommendation

Based on the results of this research, the suggeestions have been proposed and addressed to these parties. The geometry learning materials with guided inductive inquiry model that have been developed should be used directly by the experienced teacher in teaching and the teacher should also more understand about the characteristics of students. The other researchers are suggested to develop learning materials in others topics which is appropriate to the procedure of developing geometry learning materials using guided inductive inquiry model in this research.

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