The Effectiveness of Guided Inquiry Learning for Comparison Topics

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Abstract. This research aims at producing a good quality learning device using guided inquiry for comparison topics and describing the effectiveness of guided inquiry learning for comparison topics. This research is a developmental research using 4-D model. The result is learning device consisting of lesson plan, student’s worksheet, and achievement test. The subjects of the study were class VII students, each of which has 46 students. Based on the result in the experimental class, the learning device using guided inquiry for comparison topics has good quality. The learning device has met the valid, practical, and effective aspects. The result, especially in the implementation class, showed that the learning process with guided inquiry has fulfilled the effectiveness indicators. The ability of the teacher to manage the learning process has fulfilled the criteria good. In addition, the students’ activity has fulfilled the criteria of, at least, good. Moreover, the students’ responses to the learning device and the learning activities were positive, and the students were able to complete the classical learning. Based on the result of this research, it is expected that the learning device resulted can be used as an alternative learning device for teachers in implementing mathematic learning for comparison topics.

1. Introduction
According to a research conducted by Camenzuli and Buhagiar [1] in 2014, it was indicated that the use of inquiry-based learning in the mathematic classroom can give benefits to students in facing social, emotional and behavioral difficulties through a number of ways. Arends [2] states that inquiry learning is another model of instruction that has been developed for the purpose of teaching students how to think. According to Kuhlthau, Maniotes, and Caspari [3], inquiry is an approach to learning whereby students find and use a variety of sources of information and ideas to increase their understanding of a problem, topic, or issue. The inquiry learning model according to Sanjaya [4] is a series of learning activities that emphasize the thinking process of searching and finding answers to a questionable problem. The thinking process itself is usually done through question and answer between teachers and students. According to Gialamas, Cherif, Keller, and Hansen [5], the guided inquiry method of teaching promotes students’ active participation in the learning process. The inquiry learning model is suitable for comparison topics because this topic is one of the topic that deals with the problems in everyday life. It is supported by the opinion of Ratzer and Jaeger [6] stating that inquiry is an investigative process that engages students in developing and answering questions as well as solving real-world problems. Besides, the majority of students indicated that they enjoyed learning mathematics through the inquiry process [7].
There are three types of inquiry studies according to Carin [8], namely guided inquiry, less structured guided inquiry, and free inquiry. In this study, the researchers chose the guided inquiry type. Based on the study conducted by Richard Meyer in 2004, it is known that in the process of inquiry learning, students learn better when they are active in learning activities, although they need guidance in doing those activities [2]. Some students cannot learn well the concept that becomes the target of inquiry. Therefore, an appropriate guidance is required. Appropriate guidance can enable students in low level to follow the ongoing activities and avoid the students in high level in monopolizing activities.

Based on the explanation above, it is clear that the purpose of this research is to produce a well-qualified learning aids using guided inquiry for comparison topics and to describe the effectiveness of guided inquiry learning for comparison topics. This research is a developmental research using 4-D model. The result of learning aids consists of lesson plan, student’s worksheet, and achievement test. Based on the result of the research in the experimental class, the learning aids using guided inquiry for comparison topics have good quality. The learning set has met the valid, practical, and effective aspects [9]. The result of the research, in terms of the implementation class, showed that the learning activities with guided inquiry has fulfilled the effectiveness indicators including the ability of the teacher to manage the learning that fulfilled the minimum criterion of good category, the students’ activity that fulfilled the minimum criterion of good category, the students’ responses to the device and the learning activity that were positive, and the students’ completion of classical learning. Based on the result of this research, it is expected that the learning aids, as the final result, can be used as alternative learning aids for teachers in implementing mathematic learning for comparison topics.

2. Methods
The procedure of developing learning aid in this research refers to the 4-D model. The four stages of the 4-D model that includes defining, designing, developing and disseminating [10]. The purpose of the defining stage is to define the requirements required in the lesson. There were five activities in this stage including front-end analysis, student analysis, concept analysis, task analysis, and instructional objectives specification. The designing stage aims at producing the initial product (prototype) learning aids using guided inquiry for comparison topics. The activities at this stage were the preparation of tests, media selection, format selection, and initial design. The developing stage aims at producing learning set with good quality. The activities at this stage were expert validation and developmental testing. The dissemination phase in this study was conducted in the same school. A good learning aids generated from the previous stage will be used in the implementation class. This implementation activity aims at determining the effectiveness of guided inquiry learning for comparison topics.

2.1. Participants
The subjects of this research were the students of class VII of SMP Negeri 1 Lembo, Morowali, Center Celebes in 2016/2017 academic year. Two classes were involved in this study. The selection of classes was randomly assigned from five classes because the placement of students in each class was conducted evenly based on the students' math skill level. There were 22 students in the experimental class and 24 students in the implementation class.

2.2. Data collection
Data were collected from validation sheet, observation sheet, student response questionnaire, and test sheet. The validation sheet and the observation sheet use the assessment criteria with the rules: 4 for very good criteria, 3 for good criteria, 2 for poor criteria, and 1 for bad criteria. The validation sheet is used to obtain the learning device validation data from three validators. The observation sheet consists of the teacher's observation sheet related to how the teacher manage the learning process used to obtain the data of teacher ability in managing the learning and observation sheet which is related the students’ activity which used to obtain the data of students’ activity. The observations were done by two observers during the learning activity. Questionnaire was used to get the students’ response related to the learning
devices and activities. The test sheet is an achievement test. This instrument is used to obtain data though pre-test and post-test.

2.3. Data analysis
The analysis is performed through data validation, data observation, analyzing students’ response from questionnaire, pretest and posttest result. Learning aids are valid if every aspect of learning aids fulfill valid criterion based on the validator assessment with score 3 or 4. The teacher’s ability in managing learning needs to be at least in good level if every observation aspect gets score 3 or 4. The students’ activity needs to be, at least, good if every aspect of observation get score 3 or 4. The data from students’ responses in students’ questionnaire were analyzed by calculating the percentage of the number of students who responded agree on each statement on the questionnaire against the number of students who completed the questionnaire. The students’ responses toward learning aids and the activities are considered positive if the percentage is at least 80% for each statement on the questionnaire. The data of the test are in the form of scores. The students’ learning completeness is classically obtained if at least 80% of students get the score ≥ 70. The achievement test of learning outcomes meets the criteria of test item validity with [11,12] in minimal if 0.40 <\( r_{xy} \) ≤ 1.00, the reliability with [11,13] in minimal if 0.40 <\( r_{11} \) ≤ 1.00, and the test item is regarded sensitive if the sensitivity index [14] \( S \geq 0.30 \). The learning aids are considered having good quality if they meet the valid, practical, and effective aspects. Guided inquiry learning for comparative material is valued effective if the teacher's ability to manage the learning meets the criteria of, at least, good level; the student activity meets the criteria of, at least, good level; the students’ responses to the learning aids and the learning activities are positive, and the students classical learning are completed.

3. Results and discussion
This section contained the exposure of the results and discussion of the research results obtained.

3.1. Results of the development of good quality learning aids
The learning aids using guided inquiry for comparison topics developed included lesson plan, student’s worksheet, and achievement test. A good quality of a set of learning aids was produced through defining, designing, and developing stages. The learning aids have been validated by three validators. The aspects of the assessment covered the aspects of content, format, and language. The experimental learning aids conducted in class VI A of SMP Negeri 1 Lembo was amounted to 22 students and conducted with the teacher as the partner and two observers. One observer observed the way the teacher managed the learning activities and one other observer observed the students’ activities. In the try-out, the researchers collected the data on teachers' ability to manage the learning process, students’ activities, students’ responses toward the learning aids and the learning activities, as well as the pre-test and post-test results. The data generated from the try-out were analyzed to determine whether the learning aids developed have good quality or not. In this study, the try-out conducted once because the results of the analysis showed that the learning aids had met the valid, practical and effective criteria.

3.1.1. Expert validation results on lesson plan, student worksheet, and learning results test. The validation results indicated that the learning aids developed categorized in valid criteria with score of 3 or 4 for each aspect of the assessment.

3.1.2. Developmental testing results. Based on the developmental testing results, the ability of teachers in managing learning for every aspect achieved core of 3 or 4. It showed that the ability of teachers in managing learning met the criteria of, at least, good level or category. The result of the observation of students’ activities during the learning process with guided inquiry, showed that the students’ activities met the criteria of, at least, good level. The observation of high, middle, and low-ability students’ activities gained score 3 or 4 for each observation aspect. Based on the analysis of questionnaires of students' responses to the learning aids and the learning activities, there were more than 80% of students agree with each statement on the questionnaire. It showed that the student's responses toward the
learning aids and the learning activities were positive. The coefficient of test item validity was at $0.59 \leq r_{23} \leq 0.93$ so that the validity of the test item was categorized into the sufficient minimum criteria. The reliability coefficient of the test was at $r_{11} = 0.74$ with the interpretation of high reliability test. Therefore, the test reliability was included in the criteria of enough. The sensitivity index of the test was at $0.30 \leq S \leq 0.80$ so that the sensitivity of the test item was included in the sensitive criterion with $S \geq 0.30$. Thus, the result of the achievement test was feasible to be used because it has met the criteria of validity of test items which was enough for minimum, the reliability was enough for minimum, and also sensitive. According to the data analysis of post-test result, it was known that 18 students got the score of $\geq 70$ so that the obtained percentage of students who completed the study was 81.8%. Based on predetermined criteria, it can be concluded that the students have completed the classical learning.

From the description above, it can be concluded that the quality of learning aids using guided inquiry was good because it has met the valid, practical, and effective criteria with the following details.

| Table 1. Achievement of a good learning aids criterion |
|-----------------------------------------------|
| **Criterion** | **Result of data analysis** |
| Valid | Each aspect of the learning aids met the valid criteria. The learning results test met the criteria of validity of test items which was enough for minimum, reliability was enough for minimum, and sensitive. |
| Practical | The ability of teachers to manage the learning met the criteria, at least, good level. The students’ activities met the criteria of, at least, good level. |
| Effective | The students’ response to the learning aids and the learning activities were positive. Students completed classical learning that at least 80% of students got the score $\geq 70$. |

### 3.2. The effectiveness of learning

In the disseminating stage, a good quality of learning aids was implemented in the VIIB class of SMP Negeri 1 Lembo, which involved 24 students. This stage aimed at knowing the effectiveness of guided inquiry learning for comparison topics. The data collected included the data of teacher’s ability in managing the learning activities, the data of students’ activities, the data of students’ responses, and the achievement test or post-test results.

#### 3.2.1. The ability of teachers in managing the learning activities

Based on the results of research in the class of implementation, it was known that the ability of teachers in managing the learning criteria got, at least, good with score 3 or 4 for each observed aspect. These results have met the requirements of the effectiveness indicators of learning. In the learning activities, the teacher was able to carry out every aspect of observation well or very well. It indicates that most of the learning activities were consistent with the guided inquiry learning steps contained in the lesson plan.

| Table 2. The observation result of the teacher’s ability in managing the learning activities |
|-----------------------------------------------|
| **No** | **Aspect of observation** | **Meeting** |
| | | **1** | **2** |
| 1 | The ability to communicate learning objectives and motivate the students | 4 | 4 |
| 2 | The ability to connect the material to be taught with prerequisite materials | 4 | 4 |
| 3 | The ability to explain the learning process | 4 | 4 |
| 4 | The ability to present problems to the students | 4 | 4 |
The ability to direct students to formulate hypotheses as possible solutions to the problems studied
The ability to guide students in the investigation to collect data and test hypotheses
The ability to direct students to make conclusions
The ability to bridge the conclusions of the students during the investigation to become a generalization
The ability to lead students to see what they have done and to analyze their thinking processes during learning

3.2.2. The Student activity. The observation result of the student activities in implementation class shows that the students’ activity has met the criteria, at least, good category with score 3 or 4 for every observed aspect. These results have met the requirements of the effectiveness indicators of learning. In the learning activities, the students were able to carry out each student activity that was observed as good or very good.

Table 3. The observation result of the students’ activity

| No | Student activities | Meeting | Student Skills |
|----|-------------------|---------|----------------|
|    |                   |         | High | Middle | Low |
| 1  | Listen and pay attention to the teacher explanations | 1       | 4    | 4     | 3    |
|    |                   | 2       | 3    | 3     | 3    |
| 2  | Read / examine the problems presented in the students’ worksheet | 1       | 4    | 4     | 4    |
|    |                   | 2       | 4    | 4     | 3    |
| 3  | Discuss to formulate hypotheses | 1       | 4    | 3     | 3    |
|    |                   | 2       | 4    | 4     | 3    |
| 4  | Collect the necessary data and test the hypothesis | 1       | 4    | 3     | 3    |
|    |                   | 2       | 3    | 3     | 3    |
| 5  | Discuss the result to formulate the conclusions | 1       | 3    | 3     | 3    |
|    |                   | 2       | 4    | 4     | 3    |
| 6  | Present the results of the group discussion or respond to the results of other group discussions | 1       | 4    | 4     | 3    |
|    |                   | 2       | 4    | 3     | 3    |
| 7  | Work on the test of individual task | 1       | 4    | 3     | 3    |
|    |                   | 2       | 4    | 4     | 3    |

3.2.3. Student Responses. The result of data analysis of student responses toward the learning aids and the learning activities showed positive response in which more than 80% of students agree with statement in questionnaire. These results have met the requirements of the effectiveness indicators of learning. The high percentage of the response supported the implementation of learning activities.

3.2.4. Post-test results. Based on the data of the post-test result, it was known that the students has completed the classical learning. There were 21 students got the score $\geq 70$ so that the obtained percentage of students who completed the study was 87.5%. Those results have met the requirements of the effectiveness indicators of learning.

Based on the description above, it can be seen that the guided inquiry learning met all four effectiveness of learning indicators. Therefore, it can be concluded that the guided inquiry learning for comparison topics was effective.

Table 4. Achievement of the learning effectiveness
The ability of the teachers to manage the learning activities
Students’ activity
Students’ responses
Students’ classical learning completion

| Indicators                                      | Result of data analysis |
|------------------------------------------------|-------------------------|
| The ability of the teachers to manage the learning activities | At least good |
| Students’ activity                              | At least good |
| Students’ responses                             | Positive |
| Students’ classical learning completion          | Achieved |

The results of the research were in line with the result of Camenzuli and Buhagiar’s [1] research showing that inquiry based learning supports student’s learning of mathematics and leads to the improvement of students’ learning achievement.

4. Conclusion

Based on the result of data analysis and discussion of the results, the development of mathematic learning set can make use of guided inquiry model for comparative material. From the overall results, it can be concluded that: the development of learning aids which includes lesson plan, students’ worksheet, and achievement test has met the criteria of good quality learning aids and the guided inquiry learning is effective to teach the comparison topics because it has fulfilled the indicators of the effectiveness of learning.

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