The Development of Illustrated Science Student Worksheets with Scientific Approach to Improve Questioning Skills and Learning Outcomes of Elementary Students Regarding Weather Theme and Its Effect on Humans

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ABSTRACT
Elementary school often applies a scientific approach to train students to discover the science phenomena. This research was intended to analyze the process, results and effectiveness after applying the illustrated science student worksheets with scientific approach concerning the weather theme and its effects on humans. The design used in this research was descriptive quantitative and done by 38 students of third grade at SDN Patrang 02 Jember Regency. The analysis of the scientific approach emphasized on research and development, quantitative and descriptive qualitative statistical data analysis. Descriptive qualitative data analysis was taken from interviews with students and questionnaires as well as the pictures of students’ works. It was obtained from the results of interviews, questionnaires and students’ work results. This test covered a large group class of 10 students and a small group class of 28 students. This research involved a large class design of 28 students and a small class of 10 students. The research instruments used were questionnaire, interview, observation, pre-test and post-test. The research analysis was tested for its validity, practicality, effectiveness, normality, homogeneity, and t-test. The results showed that the illustrated science student worksheets with scientific approach developed were valid, practical and effective. According to the analysis on the results of pre-test and post-test in a small class (10 students), there was an increase in the percentage from 58.08% to 83.3%. The analysis on the results of the pre-test post-test in a large class (28 students) got an increase from 54.44% to 88.7%. It claimed that the results of pre-test and post-test developed in the illustrated science student worksheets with scientific approach in both small and large classes improved the students’ questioning skills and learning outcomes during their learning in weather theme and its effects on humans at SDN Patrang 02 Jember

Key Words: scientific approach, questioning skills, learning outcomes.

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INTRODUCTION

Science learning aimed to promote the students’ scientific thinking including formulating research problems, designing a research which consisted of doing observation, explaining, developing theories, and studying the other researches (Chin and Malhotra 2002; Chin and chin 2006).

The scientific approach or scientific process-based approach refers to organizing learning experiences in logical sequence of learning process covering observing, asking questions, gathering information/giving a try, reasoning/associating and communicating. It was in accordance with the research done by Aktamis & Ergin (2008) which claimed that scientific steps referred to observation (observing), analyzing, formulating hypotheses, trying (experimenting), concluding, and generalizing.

**Table 1.** The Objective Assessment of Scientific Learning

| Indicators                  | Description                                                                                                                                 |
|-----------------------------|---------------------------------------------------------------------------------------------------------------------------------------------|
| Observing                   | A concern-being when observing an object/reading an article/listening to an explanation, notes written about what was observed, patience, time (on task) used to observe |
| Asking                      | The type, quality, and number of questions asked by students (factual, conceptual, procedural, and hypothetical questions)                     |
| Gathering Information       | The number and quality of sources studied/used, completeness of information, validity of information collected, and instruments/tools used to collect data. |
| Reasoning/Associating        | Developing interpretations, arguments and conclusions in relation to the relationship of information of two facts/concepts, interpretation of arguments and conclusion on how more than two facts/concepts/theories linked, synthesize and argumentation as well as conclusions concerning the relationship between various types of facts/concepts/theories/opinions; developing interpretations, new structures, arguments, and conclusions that led to the relationship of facts/concepts/theories from two or more contradictory sources; developing interpretations, new structures, arguments and conclusions from different concepts/theories/opinions from various types of sources. |
| Communicating               | Presenting the results of the study (from observing to reasoning) in the form of writing, graphics, electronic media, multimedia and others          |

Supriyadi (2013:158) defined questioning skill as a skill used to get answers or feedback from others. Questioning skill referred to the person’s ability in having the question and answer so that it ran well and conducive. Wudijaya (2014) revealed that questioning skill was an ability to express curiosity both orally/in writing which began with the question words "what, why, how much, when, who, where and how" to the one who were going to be asked to get some information. Based on several perspectives that have been put forward, it can be
concluded that learning is a mental (psychic) activity that takes place in interaction with the environment that produces changes that are relatively constant. Worksheets is one form of teaching materials that are often used in schools and can help teachers and students in learning. A good Worksheets is one that is able to make it easier for students to understand the material being studied. A good Worksheets can also facilitate students in carrying out meaningful learning activities.

Based on the description above, the problems in this research were as follows; First, how to develop illustrated science student worksheets with a valid scientific approach to improve the students’ questioning skills and learning outcomes?; Second, how to develop illustrated science student worksheets with a practical scientific approach to improve the students’ questioning skills and learning outcomes?; Third, how to develop illustrated science student worksheets with an effective scientific approach to improve students’ questioning skills and learning outcomes?

**METHODOLOGY**

This research was intended to develop the science student worksheets of 3rd grade students which had relation with scientific approach. The type of this research was research and development method or Research and Development (R&D). The model used was the development of a 4-D model. The 4-D development model (Four D) was a learning instrument development model. This model was developed by Thiagarajan covering 4 main stages: Define, Design, Develop and Disseminate. This description illustrated in the research framework chart is shown in the following figure.

**2.1 Population**

This research involved a total of 38 students of class III at SDN Patrang 02. This research used two classes, which were large class and small class.

| Class       | Gender | Total |
|-------------|--------|-------|
| Small Group | M 5    | F 5   | 10   |
| Large Group | 13     | 15    | 28   |

**2.2 Instrument**

The instruments used in the research were; pre-test and post-test, validation sheet, questionnaire and interview. The tests used as pre-test and post-test were in the form of 20 essay questions. The validation sheet was used to refine the results, with five categories, namely very valid (score 5), valid (score 4), quite valid (score 3), less valid (score 2), and invalid (score 1). The questionnaire contained statements with closed answers using the Linkert scale with five categories, namely very interesting (score 5), interesting (score 4), quite interesting (score 3), less interesting (score 2), and not interesting (score 1). The last was interview which that came with the open questionnaire for student worksheets
2.3 Data Collection and Analysis

The data collection was done by pre-test and post-test both in the experimental and the control classes. In addition, the researchers also conducted observations and interviews with research subjects. Guided inquiry-based science student worksheets (LKPD) became a tool that can help students to build their own knowledge. In applying the illustrated science student worksheets with a scientific approach, the teacher acted as a mentor and motivator who provided...
opportunities for students to learn actively by not providing knowledge in its final form, but by guiding students to make observations and conclude the knowledge provided by themselves.

To measure the level of validity of the student worksheets (LKPD), the data analysis needed was quantitative data analysis of the values obtained from the validator after validation activities. Questionnaires were given in the form of Likert scale which consisted of a score of one to four, and this assessment was made in the form of a checklist (✓). Meanwhile, to determine the extent of the level of validity, the quantitative data were analyzed using the following formula:

\[
Earning\ score = \frac{\text{Maximum score}}{\times 100}
\]

The assessment of the validation results used the conversion of the level of achievement scale because in a research, a standard of achievement (score) is needed and is adjusted to the predetermined category. For the validity interval, we can see in the following table:

| Score               | Qualification | Information        |
|---------------------|---------------|--------------------|
| 81 < score ≤ 100    | Very Valid    | No revision needed |
| 61 < score ≤ 80     | Valid         | No revision needed |
| 41 < score ≤ 60     | Quite Valid   | Need revision      |
| 21 < score ≤ 40     | Less Valid    | Need revision      |
| < 20                | Invalid       | Need revision      |

The practicality level of student worksheets was measured by using qualitative descriptive data analysis. Meanwhile, to find out how high the practicality level of developing illustrated science student worksheets with this scientific approach can be through two instruments, they are:

a. Interview guide sheet conducted with the teacher
b. Response sheets given to students

To find out the effectiveness of the illustrated science student worksheets with a scientific approach improving science process skills and students’ learning outcomes in elementary schools, it can be known by using the gain normality test or commonly called the N-Gain. The gain normality test (N-Gain) was conducted to determine the increase of students’ questioning skills and learning outcomes after being given the learning treatment using illustrated science student worksheets with a scientific approach. The increase was obtained from the pre-test and post-test scores obtained by students. Normalized gain was a comparison of the actual gain score with the maximum gain score, the actual gain score is the gain score obtained by students, while the maximum gain score is the highest gain score that students may obtain. Application of N-Gain can be done with the following formula:

\[
<\text{g}> = \frac{\text{Posttest score} - \text{pretest score}}{\text{Max score} - \text{pretest score}} \times 100\%
\]

The results of the normalized gain score (N-Gain) were divided into three categories as
shown in the following table;

**Table 4. of N-Gain Score Criteria**

| N-Gain Score          | Category |
|-----------------------|----------|
| N-Gain > 70           | High     |
| 30 ≤ N-Gain ≤ 70      | Medium   |
| N-Gain < 30           | Low      |

Meanwhile, the distribution of N-Gain acquisition categories in the form of percent (%) which can be used to determine the classification of the interpretation of the effectiveness of the illustrated science student worksheets with a scientific approach to improve students’ questioning skills and learning outcomes can be seen from the following table:

**Table 5. Classification of Interpretation of Effectiveness of Student Worksheets**

| N-Gain Score           | Interpretation |
|------------------------|----------------|
| 81% < score ≤ 100%     | Very effective |
| 61% < score ≤ 80%      | Effective      |
| 41% < score ≤ 60%      | Quite Effective|
| 21% < score ≤ 40%      | Less effective |
| < 20%                  | Ineffective    |

At this stage, the researchers’ task has been completed since has provided scientific evidence as well as existing empirical evidence. In addition, researchers have concluded the level of validity, practicality and effectiveness of the illustrated Science student worksheet product with the resulting scientific approach.

**RESULT AND DISCUSSION**

The steps included the phases of define, design, develop and disseminate. The device development process was carried out by validating and testing the effectiveness of the developed learning devices.

3.1 Define

There are 5 stages in the definition stage which is the initial stage of analyzing the objectives and limitations of the material to determine and define learning needs. The five stages include:

**Table 6. The Five Stages In The Definition Stage**

| Stages       | Description                                                                 |
|--------------|-----------------------------------------------------------------------------|
| Front-end analysis | 1. Conduct curriculum analysis  
2. Develop a map of class needs  
3. Determining the title of the student worksheet |
| Learner analysis | Through the results of observations and interviews conducted with teachers and students |
### Stages

| Stages                        | Description                                                                                     |
|-------------------------------|------------------------------------------------------------------------------------------------|
| Concept Analysis              | Determination of content and material in accordance with the basic concepts and scientific approach. |
| Task Analysis                 | The task given in this research was about developing illustrated science student worksheets, in which students were expected to be able to complete assignments using a scientific approach. |
| Specifying Instructional     | Determine or formulate learning objectives to be achieved by students. The specification of this learning objective is in the form of achievement as follows:  
  a. Students play an active role during learning and work together in understanding the material using a scientific approach.  
  b. Students can improve their questioning skills in learning activities. |

#### 3.2 Design

This stage is used to design the learning device for the illustrated Science Student Worksheet (LKPD) with a scientific approach to weather material which aims to determine the effect on questioning skills and student learning outcomes. This plan has several steps, including the following:

| Table 7. The Stage of Scientific Approach |
|-------------------------------------------|
| Stages                                    | Description                                                                                     |
| Test preparation                          | Carry out test preparation activities in accordance with research and related to the material being studied. The test used was in the form of essay adapted to learning and a scientific approach. |
| Media Selection                           | Selection of image media according to the characteristics of students. The use of the media used was the development in the form of illustrated Science student worksheet with a scientific approach. |
| Format Selection                          | Designing content, selecting learning strategies and learning resources. The format used in the illustrated Science student worksheet was a scientific approach model. |
| Preliminary Design                        | This stage was designing items:  
  a. Lesson Plan (RPP)  
  b. Student Worksheet (LKPD)  
  c. Learning Outcomes Test |

#### 3.3 Develop

This stage contained the activities of making the design into a product and testing the validity of the product repeatedly until a product that meets the specifications is produced. This stage has two steps, namely the validation by experts and field trials.
a. Expert validation. This research used two validators to validate the learning devices developed.

### Table 8. Student Worksheet Validation Recapitulation

| No | Rated Aspect                                                  | Validator 1 | Validator 2 | Average |
|----|--------------------------------------------------------------|-------------|-------------|---------|
|    | I. CONTENTS PROVIDED                                          |             |             |         |
| 1  | Student worksheet was presented systematically               | 4           | 3           | 3.5     |
| 2  | The material in the student worksheet was accurate in accordance with the expected competencies | 4           | 4           | 4       |
| 3  | The images presented were in accordance with the students' cognitive level | 4           | 3           | 3.5     |
| 4  | Each activity reflected the stages of a scientific approach   | 3           | 4           | 3.5     |
|    | II. LANGUAGE                                                 |             |             |         |
| 5  | Use of language according to Indonesian Spelling System      | 3           | 3           | 3       |
| 6  | The language used was in accordance with the level of students' cognitive development | 4           | 4           | 4       |
| 7  | The language used was communicative                          | 4           | 4           | 4       |
| 8  | The sentences used were clear and easy to understand         | 4           | 4           | 4       |
| 9  | Clarity of Instructions or directions                        | 4           | 4           | 4       |
|    | Total                                                        |             |             | 33.5    |
|    | Max score                                                    |             |             | 36      |
|    | Score                                                        |             |             | 93      |
|    | Percentage                                                   |             |             | 93%     |

Based on the validation criteria, if the validation score was between 81%-100%, the lesson plan developed by the researcher was valid. The table shows that the overall assessment of validator 1 and validator 2 obtained 93% results with valid criteria and no revision is needed.

Preparation of teaching materials, preparation of worksheets, and evaluation instruments are carried out at this stage. An initial form, a draft worksheet was developed. Then proceed with compiling the cover of the illustrated science worksheets with a scientific approach as shown in the following table:

### Table 9. Illustrated Science Student Worksheets with Scientific Approach
### No. Activity Illustrated

| No | Activity | Weather symbol |
|----|----------|----------------|
| 1  | worksheet 1 |               |
| 2  | worksheet 2 |               |
| 3  | worksheet 3 |               |
| 4  | worksheet 4 |               |

#### b. The student worksheet Practicality

**Table 10. Recapitulation of student worksheet Practicality**

| No. | Aspects                                   | Validator 1 | Validator 2 | Mean | Note |
|-----|-------------------------------------------|-------------|-------------|------|------|
|     | Introduction                              |             |             |      |      |
| 1.  | Opening with greetings and prayers        | 4           | 4           | 4    |      |
| 2.  | Stating the learning objectives           | 4           | 3           | 3.5  |      |
| 3.  | Motivating the students                   | 3           | 4           | 3.5  |      |
| No. | Aspects                                      | Validator 1 | Validator 2 | Mean | Note |
|-----|----------------------------------------------|-------------|-------------|------|------|
| 4.  | Stating the learning material                | 4           | 3           | 3.5  |      |

II. Core activities

1. Organizing students into heterogeneous learning group  
   3 4 3.5
2. Distributing the student worksheet to be done in group  
   4 3 3.5
3. Giving reference (initial knowledge) in the form of research journal and explanation  
   4 4 4
4. Observing the students during discussion and provide explanation  
   4 3 3.5
5. Asking the students to present the discussion result  
   4 4 4
6. Evaluating the discussion  
   3 4 3.5

III. Closing

1. Guiding students to draw conclusion  
   4 4 4
2. Presenting the material to be taught in the next meeting  
   4 4 4
3. Closing with salaam and du’a  
   4 4 4

Total 48.5
Total score for all aspects 52
Mean score for all aspects 93
Percentage 93%

Based on the indicator score table on the observation sheet, it shows that the overall assessment of validator 1 and validator 2 obtained 93% results with practical criteria and no revision is needed.

c. The student worksheet Effectiveness

1. Questioning Skill

a. Small class. Comparison of Questioning Skill result in Small Class

Table 11. Comparison of Questioning Skill result in Small Class

| No | Statements                                                                 | Score | Deviation | Gain score |
|----|-----------------------------------------------------------------------------|-------|-----------|------------|
|    |                                                                             | Pretest| Posttest  |            |
| 1  | The students ask relevant question based on the material during the learning | 2     | 8         | 6          | 0,75      |
| 2  | The students ask critical questions                                         | 2     | 7         | 5          | 0,625     |
| 3  | The students ask question due to interested in learning the material        | 2     | 7         | 5          | 0,625     |
| 4  | The students raise hand and introduce themselves before asking question     | 3     | 10        | 7          | 1         |
| 5  | There is student asking question for one hour learning                       | 3     | 10        | 7          | 1         |
Based on the table above, information is obtained on the results of students' Questioning Skill in small classes. The table shows the students' asking skills in small classes to get 083,3% results with high criteria. Based on the indicator score table on the observation sheet, it shows that the overall assessment of validator 1 and validator 2 obtained 83,3% results with effectiveness criteria and no revision is needed.

b. Large class. Comparison of Questioning Skill in Large Class

Table 12. Comparison of Questioning Skill in Large Class

| No | Statements                                                                 | Score | Score deviation | Gain score |
|----|---------------------------------------------------------------------------|-------|-----------------|------------|
|    |                                                                          | Pretest | Posttest |                  |
| 1  | The students ask relevant question based on the material during the learning | 10     | 24      | 14             | 0,777     |
| 2  | The students ask critical questions                                        | 9      | 25      | 16             | 0,842     |
| 3  | The students ask question due to interested in learning the material       | 9      | 24      | 15             | 0,789     |
| 4  | The students raise hand and introduce themselves before asking question    | 12     | 28      | 16             | 1         |
| 5  | There is student asking question for one hour learning                      | 10     | 28      | 18             | 0,944     |
| 6  | The students use standard language when asking                             | 8      | 24      | 16             | 0,8       |
| 7  | The students use question word when asking (what, who, when, where, why, and how) | 12     | 28      | 16             | 1         |
| 8  | The students use loud voice when asking question                           | 10     | 25      | 15             | 0,833     |
| 9  | The students are serious when asking question (not laughing)               | 10     | 28      | 18             | 1         |
|    | Total                                                                     |         |         |                | 7,985     |
|    | Mean                                                                      |         |         |                | 0,887     |
|    | Percentage                                                                |         |         |                | 88,7      |
Based on the table above, information is obtained on the results of students' Questioning Skill in large classes. The table shows the students' asking skills in small classes to get 88.7% results with high criteria. Based on the indicator score table on the observation sheet, it shows that the overall assessment of validator 1 and validator 2 obtained 88.7% results with effectiveness criteria and no revision is needed.

2. Learning Outcomes.

Table 13. Test of Homogeneity Pre-Test Data

| Levene Statistic | df1 | df2 | Sig. |
|------------------|-----|-----|------|
| Pre-test Based on Mean | .187 | 1 | 36 | .668 |
| Based on Median | .010 | 1 | 36 | .923 |
| Based on Median and with adjusted df | .010 | 1 | 23,446 | .923 |
| Based on trimmed mean | .163 | 1 | 36 | .689 |

The results of the homogeneity test of the pre-test values of the two classes obtained the Levene Statistic (F) value of 0.187 with a significance value of 0.668. The significance value is greater than the value of (0.05). This means that the pre-test data between the two classes (Control and Experiment) has a homogeneous variance, so that further tests can be carried out.

Table 14. Test of Independent T-test Data Pre-Test

| Levene's Test for Equality of Variances | t-test for Equality of Means |
|----------------------------------------|-----------------------------|
| F Sig. t d g. (2 tailed) Si Mean Differen Std. Error Differen Lower Upper 95% Confidence Interval of the Difference |
| Pr Equal variances assume t test | .187 .668 .034 36 .973 .143 4,246 -8,468 8,753 | |
Based on the table, the results of the t-test of independent data, the pre-test value between the control and treatment classes, obtained a t-count value of 0.034 with a significance value of 0.973. The significance value is greater than the value of (0.05). This means that there is no difference in average between the control and experimental classes before the treatment (pre-test), so the assumption that the control class and the experimental class have a homogeneous average is fulfilled.

Table 15. Independent T-test of Post-Test Data

|                    | Levene's Test for Equality of Variances | t-test for Equality of Means |
|--------------------|----------------------------------------|-----------------------------|
|                    | F       | Sig. | t     | d    | Sig.     | Mean Difference | Std. Error Difference | Lower 95% Conf. Int. | Upper 95% Conf. Int. |
| Equal variances    | 3.030  | .090 | 3.914 | 36   | .000     | -16.143         | 4.124                 | -24,507             | -7,779              |
| Not assumed        | -22.70 | .000 | -16.143 | 3,497 | .000     | -23,383         | 8,903                 |                      |                    |

The results of the t-test of independent data post-test values between the control and treatment classes obtained a t-count value of -3.914 with a significance value of 0.000. The significance value is smaller than the value of (0.05). This means that there is an average difference between the control and experimental classes after treatment (post-test). The negative sign on the t-count value indicates the average of the experimental class is higher than the control class.
a. Small class

![Small Class](image)

**Figure 2. The Percentage Of Students' Learning Outcomes on Small Class**

Based on the diagram above, the result of pretest and posttest was 76.3% within the score of >70, therefore, it can be concluded that the result was categorized as high.

b. Large class

![Large Class](image)

**Figure 3. The Percentage Of Students' Learning Outcomes on Large Class**

Based on the diagram above, the result of pretest and posttest was 79.3%, therefore, it can be concluded that the result was categorized as high.

3.4 Disseminate

In the disseminate stage, the learning device was disseminate to other classes or schools. The aim was to know the effectiveness of the learning device and to obtain feedback and assessments to further refine the learning device.

CONCLUSION

Based on the result and discussion of this research, it can be concluded that: **First**, the level of validity toward the result of Illustrated Science student worksheet development with scientific approach to improve elementary students’ questioning skill and learning outcomes on weather theme and its effect for human obtained overall validation as many as 93% which means it was valid and need no revision. **Second**, the level of practicality of Illustrated Science student worksheet development with scientific approach to improve elementary students’ questioning skill and learning outcomes on weather theme and its effect for human which measured through descriptive quantitative data analysis. The result showed that teachers felt that the Illustrated Science student worksheet development with scientific approach improved elementary students’ questioning skill and learning outcomes. **Third**, the effectiveness level of Illustrated Science
student worksheet development with scientific approach to improve elementary students’ questioning skill and learning outcomes on weather theme and its effect for human, which measured through gain normality test or which commonly called N-Gain. The score obtained was 88.7% which could be classified as very effective. Therefore, this research had produced Illustrated Science student worksheet development with scientific approach to improve elementary students’ questioning skill and learning outcomes on weather theme and its effect for human at SD Negeri Patrang 02.

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