The development of performance assessment of inquiry-based learning (IBL) to improve student’s science process skill of class XI Senior High School 1 Bayang

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Abstract. This research is motivated by low learning process and authentic assessment in class and low science process skill which is exercised on the students. The purpose of this research is to develop performance assessment of inquiry-based learning which is valid, practical and effective, and to analyze the influence of developed product toward student’s science process skill improvement. This is a research and development study with a 4-D development model consists of 4 stages define, design, development and disseminate. The research subject is students of class XI Mathematics and Natural Science of Public Senior High School 1 Bayang Academic Year 2017/2018. The research instruments are validation instrument, practicality instrument, and effectiveness instrument. The research result shows that performance assessment of inquiry-based learning is valid and practical and effective to be employed in the learning process since performance assessment of Inquiry based learning has proven to be able to improve learning result and student’s science process skill.

1. Introduction

Education new paradigm is of vital importance in the globalization era in order to create a golden generation equipped with learning, adapting, and innovating capacities. The existence of 2013 curriculum is to answer the challenge and the building of paradigm shift of 20th century to 21st century. This curriculum implementing the learning process reinforcement through scientific approach which is not only consider learning result as the final achievement, but consider the process of learning as a crucial matter [1]. Hence, physics learning process emphasizes more on science process aspect. Exercising on science process skill is one of important effort to achieve an optimum student learning result. Learning material would be much easier to be understood, to be comprehended and to be remembered in a relatively long term particularly if students learning by observing or experimenting [2]. Science process skill consists of skills which can not be separated from one another such as observation, questioning (formulating problem), hypothesis, planning, experimenting, concept implementation, communication and data interpretation [3]. The observation results at Public Senior High School 1 Bayang revealed that low learning percentage of student center. Low percentage on the implementation of practical activity indicated that procedural material is less implemented. Low percentage of skill assessment by using performance assessment revealed that practical work is less implemented. Low assessment percentage of students working process measurement signified that the low authentic learning assessment implementation as required by 2013 curriculum. The low
percentage of science process skill indicator revealed that the implementation of practical work has yet shows scientific atitude as to has yet fulfill the nature of the physics itself. As the effect students learning result is low in which most of them fail to pass the (minimum completeness criteria) KKM. Hence, this problem needs to be solved in order to achieve learning process which is in line with the demand of 2013 curriculum.

The observation results at Public Senior High School 1 Bayang revealed that inquiry-based learning model is appropriate in solving the existed problem. Inquiry based learning (IBL) is an investigation process to obtain information [4], which involving students in formulating the questions to lead to investigation to build the new knowledge and definition [5], it is flexible and open up and refer to skill and great variety of learning resources in which teacher plays role as partner to the students and so to coach, facilitate and to guide the students learning experience to achieve certain goal [6]. Inquiry based learning (IBL) consists of five learning phases namely orientation, conceptualization, investigation, conclusion, and discussion [7].

Learning process in 2013 curriculum will be meaningfully by using authentic assessment, since it assesses the student’s readiness, also the whole process and result of learning. This is in line with the fact that learning process in 2013 curriculum context emphasizes more on student’s skill development. Hence, it is of vital importance that the teacher fully masters the performance assessment technique to allow a correct, valid and reliable students assessment [8]. The performance assessment is appropriate for the existed problem. The performance assessment requires the students to do task in a practical work that allowing teacher to observe [9], students demonstrate and applied knowledge into context which suits the criteria [10] such as designing experimentation, conducting presentation and writing the report result. The instrument of performance assessment can be developed based on the tasks that are expected to be performed by the students through stages such as identify the learning achievement standard, develop the authentic task, establish performance assessment, and develop the assessment column [11].

The problem found in the field indicates the importance of assessment development which is in line with 2013 curriculum namely performance assessment, and learning process as demanded by 2013 curriculum through implementing inquiry-based learning which is expected to be able to improve student’s science process skill.

2. Method

2.1. Model and Procedure of Development

This is a research and development study since it develops performance assessment. 4D model is employed in this research which consists of four stages: define, design, development and disseminate [12]. The define stage is to establish the learning requirements and to analyze basic competence and learning material limitation based on the content standard of 2013 curriculum on 2016 revision. This stage analyzes two aspects namely final initial analysis and student’s analysis. The final initial analysis includes curriculum analysis, material analysis, task analysis, learning purpose analysis. Meanwhile student’s analysis includes physics learning interest analysis, science attitude analysis, physics learning motivation analysis, learning style analysis, science process skill early analysis.

The design stage aimed to design learning product and research instrument. The design learning product involving Lesson Plan and performance assessment. The lesson plan is designed based on the regulations of ministry of education and culture N. 22 Year 2016 about standard process of elementary school and high school. The performance assessment is designed based on the stages of performance assessment instrument development as proposed by Ridwan Abdullah Sani (2016). Research instrument involving instrument assessment sheet of lesson plan and performance assessment, and practicality instrument assessment sheet of both teacher and students’ responses toward performance assessment.

The development stage is to produce development product through two steps, namely: 1) expert appraisal including content validation, construction and language which consists of three expert
lecturers and two practitioners (teachers), 2) development testing to see how far the practicality of lesson plan and performance assessment which developed in learning.

The disseminate stage aimed to use lesson plan and performance assessment which is valid and practical in a bigger class to test the effectivity of developed product.

2.2. Test Subject
The research subject is students of class XI Mathematics and Natural Science of Senior High School 1 Bayang of Academic Year 2017/2018.

2.3. Data Collection Instrument
Instrument employed in collecting data in this research is validation, practicality instrument and effectivity instrument. Validity criteria consists of lesson plan instrument validation sheet, performance assessment, teacher response questionnaire toward (lesson plan practicality, lesson plan Implementation practicality, performance assessment practicality), students response questionnaire toward performance assessment practicality. The effective criteria consist of test instrument to measure knowledge competence and non-test instrument to measure attitude and skill competencies.

2.4. Data Analysis Technique
Validity of this research can be seen if the value of cohen kappa (K) ≥ 0.6. The validity criteria can be seen on Table 1.

| No | Validity Indicator | Achievement Criteria |
|----|-------------------|----------------------|
| 1  | Lesson Plan       | If the average assessment of experts shows K ≥ 0.6 then the category is valid |
| 2  | Performance Assessment | |

The practicality in this research is analyzed from teacher and student responses with the average practicality value P ≥ 75 toward performance assessment, teacher response of practicality average value P ≥ 75 toward lesson plan. The impracticality criteria can be seen on Table 2.

| No | Practicality Indicator | Achievement Criteria |
|----|------------------------|----------------------|
| 1  | Teacher Response       | If the average assessment of teacher and students responses shows P ≥ 75 and then the category is practical and very practical |
| 2  | Students Response      | |

The effectiveness of this research can be seen from: 1) students achievement completeness both individually and classically, 2) the improvement of science process skill indicated by N-gain score calculation. The effectiveness criteria can be seen on Table 3.

| No | Practicality Indicator | Achievement Criteria |
|----|------------------------|----------------------|
| 1  | Students achievement completeness both individually and classically | $T_k \geq 75\%$ (25 of 33) students achieved classical completeness, $K_i \geq 75$ |
| 2  | The improvement of science process skill | $\langle g \rangle > 0.3$ and is in the moderate category |

3. Results

3.1. Define
The define stage is to conduct final initial analysis and student’s analysis. The final initial analysis consists of curriculum analysis, material analysis, task analysis, and learning purpose analysis. Curriculum analysis consists of graduate competence standard analysis (SKL), process standard, content standard and assessment standard, KI and KD. The result of curriculum analysis can be seen on Table 4.

**Table 4. The Result of Curriculum Analysis**

| No | Dimension              | Result                                                      |
|----|------------------------|-------------------------------------------------------------|
| 1  | SKL analysis           | The regulation of ministry of education and culture, Number  |
|    |                        | 20 Year 2016                                               |
| 2  | Content standard analysis | The regulation of ministry of education and culture Number   |
|    |                        | 21 Year 2016                                               |
| 3  | Process standard analysis | The regulation of ministry of education and culture Number   |
|    |                        | 22 Year 2016                                               |
| 4  | Assessment standard analysis | The regulation of ministry of education and culture Number |
|    |                        | 23 Year 2016                                               |
| 5  | KI and KD analysis     | The regulation of ministry of education and culture Number  |
|    |                        | 24 Year 2016                                               |

The result of the curriculum analysis revealed numbers of indicators with low percentage namely 1) student center learning (43.94%), 2) the implementation of practical work (46.97%) which indicates less implementation on procedural material, 3) skill assessment by using performance assessment (38.64%) which shows less implementation on practical work, 4) assessment to measure the process of students work (40.15%) which shows less implementation on authentic assessment in learning as demanded by 2013 curriculum.

The result of material analysis, task analysis, and learning purpose analysis which is in line with this research is class XI material, rotation dynamics and rigid thing equilibrium.

Students analysis consists of physics learning interest, science attitude analysis, physics learning motivation analysis, learning style analysis, science process skill initial analysis. The result of student’s analysis can be seen on Table 5.

**Table 5. The Result Students Analysis**

| No | Dimension           | Result  |
|----|---------------------|---------|
| 1  | Physics learning interest | 59.1%   |
| 2  | Science attitude    | 68.9%   |
| 3  | Learning motivation | 64.6%   |
| 4  | Learning style      | 53.8%   |
| 5  | Science process skill | 48.83% |

The result of student’s analysis revealed that the lowest dimension on science process skill is (48.83%) with science process skill indicator such as observation skill (41.67%), questioning skill (25%), hypothesis skill (25%), planning experimentation skill (51.36%), experimenting skill (51.36%), concept application skill (61.04%), communication skill (59.09%), and data interpretation skill (60.61%). The low indicator of science process skill is caused by the infrequently implementation of scientific research.

The result of final initial analysis and student’s analysis indicates the importance of a particular learning which allowing direct learning experience to enable students to be actively engaged in every steps of scientific process activity as to exercise the science process skill during the research. This activity is in need to be assessed to assure that it is in line with the nature of the science itself. This is to reveal that learning process and assessment possesses the same essential level. Therefore,
performance assessment with inquiry-based learning is crucial to be implemented. It is expected that it may improve the student’s science process skill.

3.2. Design
Performance assessment is designed through instrument development phases which was developed by Sani (2016) by utilizing stages on Table 6.

| Phase | Description |
|-------|-------------|
| 1. Cover | Cover contains product identity of performance assessment by using inquiry based learning model. The materials employed are rotation dynamics and rigid thing equilibrium. The pictures on the cover show the implementation of rotation dynamics in daily life. The identity of the author and the production year are also included. |
| 2. Identifying the final achievement standard | This phase contains basic competence (KD) and indicator of performance sheet which have to be done by the students in learning. |
## Phase Description

1. **Orientation phase** is to exercise and to assess authentic task which is observation skill.
2. **Conceptualization phase** is to exercise and to assess authentic tasks which are questioning skill and hypothesis skill.
3. **Investigation phase** is to exercise and to assess authentic tasks which are planning experimentation skill, concept implementation skill, and communication skill.
4. **Conclusion phase** is to exercise and to assess authentic task which is data interpretation.
5. **Discussion phase** is to exercise and to assess authentic task which is communication skill.

### 4. Establishing assessment criteria

Assessment criteria consists of behavior that will be observed and assessed.

### 5. Developing assessment rubric

This phase employed holistic rubric. The score obtained depends on the amount of assessment criteria which is done correctly. The skills observed in developing the rubric are observation skill, questioning skill, hypothesis skill, planning experimentation skill, concept implementation skill, communication skill, and data interpretation skill.
3.3. Development
This stage consists of two activities namely expert appraisal and development testing. Following is the description of each:

3.3.1. Expert appraisal. Validation is conducted by three validators (3 lecturer from Padang State University and 2 practitioners/physics teacher). Table 7 displays the result of validation.

| No | Instrument                  | K     | Category |
|----|------------------------------|-------|----------|
| 1  | Lesson Plan                  |       |          |
| 1  | Content Validation           | 0.92  |          |
| 2  | Construct Validation         | 0.88  |          |
| 3  | Language Validation          | 0.91  |          |
|    | Average                      | 0.90  | Valid    |
| 2  | Performance Assessment       |       |          |
| a  | Content Validation           | 0.87  |          |
| b  | Construct Validation         | 0.90  |          |
| c  | Language Validation          | 0.88  |          |
|    | Average                      | 0.88  | Valid    |

According to Table 7, the result of Lesson Plan validation analysis and performance assessment signified that the developed product is valid.

3.3.2. Development testing. After the product stated as valid, the next step is to conduct field experiment. The experiment is implemented to one class, XI Mathematics and Natural Science 3 at Public Senior High School 1 Bayang. The experimentation is conducted for 4 meetings. The experiment aimed to see the practicality of Lesson Plan and performance assessment. The result of experiment can be seen on Table 8.

| No  | Dimension                                      | Average (P) | category  |
|-----|-----------------------------------------------|-------------|-----------|
| 1   | Lesson Plan (teacher response)                | 86.72%      | Very practical |
| 2   | The Implementation of Lesson Plan (teacher response) | 85.20%      | Very practical |
| 3   | Performance Assessment (teacher response)     | 83.07%      | Very practical |
| 4   | Performance Assessment (students response)    | 81.09%      | Very practical |

Based on Table 8, the field experiment result of developed product is practical as the learning material.

3.3.3. Disseminate. This stage is a test effectiveness. This test is to measure the effectiveness of performance assessment that has stated as valid and practical in order to improve science process skill and students learning result.

3.3.4. Knowledge Competence. The knowledge competence assessment is through multiple choice test/essay. The average score of first meeting (79,73), second meeting (79,55), third meeting (79,55), and fourth meeting (78,41). The average value of total knowledge competence of 4 meetings is 78.35 and is in good category.
3.3.5. **Attitude Competence.** The assessment of attitude competence is through multiple choice test/essay. The average score of first meeting (72.98), second meeting (75.76), third meeting (82.58), and the fourth meeting (82.07). The average value of total knowledge competence of 4 meetings is 79.59 and is in good category.

3.3.6. **Science process skill Competence (KPS).** There are 8 assessed indicators of KPS and each has different percentage as can be seen in Figure 1.

![Figure 1. Average Graph of Science Process Skill Achievement](image)

Based on Figure 1, the average value of science process skill of first meeting (63.07), second meeting (75.66), third meeting (84.09), and fourth meeting (89.87). The average value of total science process skill of four meetings is 78.17 and is in skilful category. The improvement of science process skill is calculated by using N-gain score, and the result can be seen on Table 9.

| Meeting                  | Pre test | Post test | N-gain | Category |
|--------------------------|----------|-----------|--------|----------|
| Meeting 1 and Meeting 2  | 63.07    | 75.66     | 0.34   | Moderate |
| Meeting 2 and Meeting 3  | 75.66    | 84.09     | 0.35   | Moderate |
| Meeting 3 and Meeting 4  | 84.09    | 89.87     | 0.36   | Moderate |
| **Average**              |          |           | 0.35   | **Moderate** |

4. **Discussion**
Performance assessment is one of the assessments that can be used to assess science process skill. Performance assessment was chosen due to its capacity to enable a whole learning. This is in line with Standford and Reeves’ [13] statement in their research which revealed that teachers are in need to implement different kind of assessments in order to obtain a more complete information of the students. Moreover, Zainul [14] also revealed that performance assessment enhances the students to
show their performance, not to choose one of the available answers, so that performance assessment may actually help to assess student’s science process skill in a fairer way.

Science process skill indicator experiencing improvement at each meeting since the students have to be actively engaged during the learning process which employs inquiry-based learning model. The students are more motivated since their performance is assessed during the learning process. This is in line with Sari’s statement in her research which revealed that performance assessment in model inquiry can improve students process skill and both are needed in the learning process [15]. Through inquiry-based learning, students are given opportunity to look for and find out themselves the answer of the questions they face through self-experimentation and scientific thinking. The skill to implement scientific method would guide the students to exercise their science process skill.

The result of performance assessment shows that the science process skill (KPS) achievement during learning process is varied in each meeting. The implementation of inquiry-based model may include experience in learning process. This is due to each stage of inquiry-based learning model can exercise the science process skill in which it is an important skill to be developed. This is in line with Simsek [16] who stated that inquiry-based learning has a positive impact toward students that is to possess science process skill themselves.

This is supported by students learning result on knowledge competence which obtain average 79.59 with 30 students or 90.91% are achieving completeness. Attitude competence obtain average 778.35 with 28 students or 84.84% are achieving completeness. And science process skill competence average 78.17 with 27 students or 81.82% are achieving completeness. Based on the result of data analysis of knowledge competence, attitude and skill, the number of students who are pass the minimum completeness criteria (KKM) is more than 25 students or more than 75% of them are achieving completeness. N-gain score of science process skill is obtaining average 0.35 which means science process skill experiencing improvement in a moderate level.

5. Conclusion

Based on the analysis result at define, design, development, and disseminate stages, it can be concluded that the developed performance assessment instrument of inquiry based learning in this research is valid and practical. The developed product also effective as learning material since it can improve students learning result and science process skill.

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