Development of authentic assessment that based on scientific approach to improve students’ skills of science process in physics learning

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Abstract. Authentic assessment is an assessment to measure and to report the progress of students’ learning achievement continuously. These learning achievements were showed as score of cognitive, affective, and skill that are integrated each other. This study aimed to obtain the valid, practical, and effective authentic assessment that based on scientific approach. Developments of this authentic assessment referred to 4D model of Thiagarajan, i.e. define, design, develop, and disseminate. This study was held until the develop phase. The obtained authentic assessment includes lab worksheet, observation sheet of scientific attitude and science process skill, written test, and rubric of scoring. Data were gathered by using test, observation, and questionnaire. Analysis process included validity test of questionnaire, practicality test of teacher and students’ questionnaire, and effectiveness test through written test, attitude and skill observation. Result of this study show that this authentic assessment is valid, practical, and effective in improving students’ science process skill.

1. Introduction

Authentic assessment is an assessment that aims to explain and to report the real students’ learning achievement. Assessment plays the important role in determining the success of education. Good assessment will give the impact to the learning process [12]. Newton stated that the some purposes of assessment are to determine the achievement level of learning objectives and to see the effectiveness of teaching-learning process [10]. Earl & Katz identified the three assessment purposes which are different but correlated each other, i.e. assessment for learning, assessment as learning, dan assessment of learning [3]. The initial observation showed that teachers experienced the difficulties in developing the authentic assessment because of the less comprehension and the more teaching tasks. Teachers assumed that the authentic assessment is an assessment over cognitive aspect in kind of giving test and observing the students’ affective and skills in the certain time.

Ideally, the authentic assessment is an assessment that contains performance tasks including aspects of cognitive, affective, and skill, and uses the scoring rubric to judge the students’ achievement in learning. Authentic assessment provides the various ways to exhibit the students’ competence [11]. Authentic assessment concerns to contextual assignments and prepare the students to explore their competencies in the real situation [2]. Result study concludes that authentic assessment is not only as
assessment process to complete the students’ learning facilities, but also as evaluation for teacher’s teaching process [1]. Another study that authentic assessment was responded by students well as alternative of test [4].

Authentic assessment has strong relevance with scientific approach concerns to complex and contextual tasks [18]. Scientific approach in physics learning requires students’ activities as scientist. It is not about routine or usual activities. Enhancement of thinking pattern, process skills, and scientific attitude namely competencies should be rewarded as students will experience the meaningful learning.

Learning with meaningful experience can be met by students while doing practices in the laboratory. Practices give students the great opportunity to enhance their science process skill. Ilmi explained that science process skill is all of scientific skill that are used in finding concepts, principles, or theories [6]. Science process skill that is enhanced in this study includes skill of observing, giving prediction, doing experiment, analyzing data, applying concepts, and communicating. This study aimed to obtain the valid, practical, and effective authentic assessment that based on scientific approach.

2. Methodology
This study took place at SMAN 1 Bukittinggi on academic year of 2016/2017. This study used the Research and Development design (R&D) with Thiagarajan 4D model. It is a model of research that includes of four phases, i.e. define, design, develop, and disseminate. Subjects of this study are classes of XI IPA 1 and XI IPA 5 that consist of 36 students and two physics teachers.

Data were gathered by using instruments of test, observation, and questionnaire. Test was aimed to determine the students’ cognitive aspect. Observation was aimed to determine the students’ scientific attitude and science process skill. Meanwhile, the questionnaire that consists of (1) questionnaire of first-end analysis was aimed to obtain the data of initial need of school and teacher; (2) questionnaire of students analysis was aimed to obtain the data of students’ characteristic; (3) questionnaire of validity was aimed to obtained the data of authentic assessment validity; (4) questionnaires of teacher and students response were aimed to obtain the practicality data of authentic assessment use. The validity data were analyzed by using the Aiken’s equation. Practicality data were analyzed by using the percentage description. Meanwhile the data of effectiveness were analyzed by using the percentage description of cognitive aspect, observation result on scientific attitude, and observation result on science process skill.

3. Results and Discussion
Phase of define obtained the analysis results of five aspects, i.e. first-end analysis, analysis of students, analysis of topics, analysis of tasks, and learning objectives. First-end analysis aimed to obtain the data of initial needs for teacher, school facilities, principle’s regulation, social condition of school, and assessment that was implemented by teacher. Three teachers were given the questionnaire containing 38 items. This analysis result showed that teacher’s performance, school facilities, principle’s regulation, and social condition of school were in high category. This means that there was a great potential to develop the authentic assessment. Unfortunately, analysis result of assessments that were used by teacher was in middle category. Teachers experienced the difficulties in doing assessment with various methods, they did not use the assessment as evaluation in planning the next learning process, they still used the written test only as assessment, they found difficulties in developing the various instruments to assess the students’ achievement because it will spend much time, and they also were not optimal in preparing the rubric of scoring.

Analysis of students was held by distributing the questionnaire to 36 students. The questionnaire consists of 32 items. Those items contain four aspects, i.e. students’ interest, learning motivation, students’ science process skill, and students’ initial skill. Analysis result showed that students’ interest, learning motivation, and science process skill were in high category while students’ science process skill was in middle category. The observed students’ science process skill was skill in practice activity.
Students still experienced the difficulties in changing and analyzing the practice result. This condition was caused by the usual practice that was held, which concern to teaching target only such that the teacher was not optimal in assessing and giving feedback to students’ performance. Analysis of topic obtained the fact, concept, principle, and procedural for topics of dynamics of rotation and the equilibrium of though objects. Analysis of tasks obtained the tasks that were appropriate to analysis of topic, i.e. performance of practice that was observed by using observation sheet of science process skill and scientific attitude, and also the written test in form of essay and multiple choices. The essay tests were given in the beginning and ending for four times meetings while multiple choices tests were given in the fifth meeting as posttest of this research. Formulation of learning objectives was arranged as reference in developing test and initial design of authentic assessment development.

Phase of design was held by arranging the blueprint of test, choosing media, determining the format of authentic assessment, and creating design of initial authentic assessment. Result of this phase was obtaining the test items for of dynamics of rotation and the equilibrium of though objects that contained indicators of science process skill. The chosen media was printed media, i.e. students’ worksheet [16]. Format of authentic assessment was arranged and based on the test blueprint, chosen media, and government regulation. Finally, the initial design of authentic assessment based on the scientific approach was obtained. It was consulted then with two guiding lecturers to get advices.

Phase of develop was held by doing validity, practicality, and effectiveness tests. It was obtained that the authentic assessment that based on the scientific approach is valid. Five experts that consisted of three lecturers and two teachers did the validation. The table below is the validity result of authentic assessment.

| No | Aspect  | Score | Criteria |
|----|---------|-------|----------|
| 1  | Content | 0.82  | Valid    |
| 2  | Construct | 0.81  | Valid    |
| 3  | Language | 0.78  | Valid    |
|    | Average  | 0.81  | Valid    |

Table 1 shows that the authentic assessment that based on the scientific approach is valid to be implemented. Validity measurement used the Aiken’s equation with range of score 0 – 1. If the score was less than 0.67, then the product was not valid. However, there were some suggestions related to revision from the valuators as the table below.

| Aspect | Revision Result |
|--------|-----------------|
| Content | Revise the items in the scoring rubric of science process skill and scientific attitude |
| Construct | Revise the layout, update the pictures, revise the page numbering, and update the cover look |
| Language | Find the general and easy to understand words, revise the punctuation, revise the sentences |

The revised product then was reported to the valuators without repeated the validity process. Experiment of the authentic assessment that based on the scientific process took place at class of XI IPA 1 SMAN 1 Bukittingi which consisted of 36 students. Experiment was aimed to obtain the practicality data through questionnaires of teacher and students. Result of the practicality test based on teacher’s response is showed in the Table 3 as follow.
Table 3. Teacher’s Response

| No | Aspect     | Percentage Score (%) | Criteria       |
|----|------------|-----------------------|----------------|
| 1  | Ease       | 87.5                  | Very practical |
| 2  | Time       | 83.3                  | Very practical |
| 3  | Usefulness | 90.6                  | Very practical |
|    | Average    | 87.2                  | Very practical |

Table 3 shows that the authentic assessment that based on the scientific approach was very practical for teacher. Teachers gave the very well responses to the authentic assessment that based on the scientific approach. These caused the physics learning in kind of laboratory practice run well, effective, and efficient. Teachers felt so helped with the existence of the scoring rubric. Teachers could determine the criteria of performance that should be assessed. The result of practicality test based on the students’ response is showed in the Table 4 below.

Table 4. Students’ Response

| No | Aspect                  | Percentage Score (%) | Criteria       |
|----|-------------------------|-----------------------|----------------|
| 1  | Graphic                | 86.1                  | Very practical |
| 2  | Language               | 85.1                  | Very practical |
| 3  | Presentation of content| 86.3                  | Very practical |
| 4  | Implementation         | 85.6                  | Very practical |
|    | Average                | 85.9                  | Very practical |

Table 4 shows that the authentic assessment that based on the scientific approach was very practical for students. Students experienced the fresh situation in physics learning, especially for practice activity. They were enthusiastic to do practice. It was caused by the given scoring rubric within their worksheet. They could know the kinds of skills that they could achieve and determine the level of their performance.

The effectiveness test of the use of authentic assessment that based on the scientific approach was held to obtain the improvement result of science process skill of 36 students. The improvement of students’ science process skill can be determined from three aspects, i.e. cognitive through the written test, observation of scientific attitude and science process skill while doing practice. Table 5 below shows the result of students’ cognitive assessment.

Table 5. Result of Cognitive Assessment

| No | Meeting  | Average Score | Completeness (%) |
|----|----------|---------------|------------------|
| 1  | First    | 84.7          | 83.3             |
| 2  | Second   | 87.4          | 91.7             |
| 3  | Third    | 86.6          | 97.2             |
| 4  | Fourth   | 89.6          | 100.0            |
| 5  | Fifth    | 82.8          | 69.4             |
|    | Average  | 86.2          | 86.1             |

Cognitive assessment from first to fourth meeting used the essay test that was given in the beginning and in the end, but the concerned score was only from the post test. In the fifth meeting, students’ cognitive were assessed by using multiple choice test. There were 30 students that passed the test in the first meeting, 33 students in the second meeting, and 35 students in the third meeting. All of students passed the test in the fifth meeting which was the last meeting of the research. Students
had the multiple choice test containing 29 items. Those items include indicators of science process skill, i.e. observing, giving prediction, planning the experiment, applying concept, and communicating. Analysis result shows that 25 students passed the test. Students experienced the difficulties with problems that need more complicated analysis. Average score was obtained by determining the average score of test result from five meetings. Result shows that students’ completeness classically is 86.1%. This score passes the standard (KKM), i.e. 80%. Result also indicates that authentic assessment that based on the scientific approach can improve students’ cognitive. Table 6 shows the result of scientific attitude assessment.

### Table 6. Scientific Attitude Assessment

| Aspect       | Percentage of Score for Each Meeting (%) | Average |
|--------------|-----------------------------------------|---------|
| Careful      | 79.9 81.6 84.7 82.6                    | 82.2    |
| Team-work    | 83.3 81.9 80.9 83.7                    | 82.5    |
| Average      | 81.6 81.8 82.8 83.2                    | 82.3    |

Tabel 6 shows the students’ scientific attitude in five meetings with two observed aspects. Two observers did the observation. Result shows that students’ scientific attitude is 82.3% and is classified as very good. This score passed the standard (KKM), i.e. 80%. Hence, the authentic assessment that based on the scientific approach is effective in improving students’ science process skill. Table 7 shows the result of students’ science process skill assessment.

### Table 7. Science Process Skill Assessment

| Aspect          | Percentage of Score for Each Meeting (%) | Average |
|-----------------|-----------------------------------------|---------|
| Observing       | 66.7 66.7 76.4 86.8                    | 79.2    |
| Giving prediction| 86.8 67.4 77.8 84.7                    | 80.7    |
| Doing practice  | 93.1 68.1 79.2 87.5                    | 82.3    |
| Analysis the data | 94.4 70.8 81.3 88.9                    | 83.5    |
| Applying concept| 93.1 75.0 77.8 90.3                    | 83.7    |
| Communicate     | 91.7 87.5 93.1 75.0                    | 85.8    |
| Average         | 82.5                                    |         |

Tabel 7 shows that assessment of students’ science process skill is very good. It exceeds the minimum score (KKM), i.e. 80%. Assessment of science process skill was held by two observers. Indicator of observing gave the lowest score. Students were not serious in observing the teacher’s demonstration before the practice and did not read the prepared worksheet. Indicator of communicate gets the highest score. This indicator was assessed by observing and checking students’ conclusion in doing practice. Assessment result of students’ science process conclude that authentic assessment that based on the scientific approach can improve students’ scientific process.

Authentic assessment that based on the scientific approach is assumed can measure the students’ comprehensive competencies in learning, not only the progress but also the process by using various tasks. This kind of assessment is fair enough for students as learner because all students’ effort is rewarded. Purpose of authentic assessment is to measure the students’ ability in doing the given assignments or test which contains the real life problems [5]. Authentic assessment can encourage students to be more active and responsible on their tasks that was given by teacher in kind of real life
provides [1]. The advantage of authentic assessment is indicated through facts of students' learning achievement that have followed the certain procedure [4]. Hence, this developed authentic assessment is an instrument which can measure the meaning of integration of cognitive, affective, and skill significantly.

Authentic assessment is one of 2013 Curriculum products. Authentic assessment is a comprehensive assessment to assess the input, process, and learning outcomes [8]. Assessment of input is assessing the students’ initial skill related to what will be learnt, for instance pretest. Assessment of process is assessing during the learning process takes place, such as performance tasks (lab work). Assessment of outcomes is assessing student competence after the learning process takes place, such as posttest. The teacher as the assessor should understand the evidence that describes the student's competence and collect all the complete information that will become the reference in the follow-up of the next lesson [15]. Jonsson stated the strength of authentic assessment depends on the conclusions about student competencies shown through performance [7]. On the other hand, authentic assessment suggests that there is a greater opportunity for teachers to assess students' readiness, processes, and outcomes after learning. Therefore, the effort to create an authentic assessment process is needed to meet the needs of curriculum, teachers, students, along with the use of facilities and infrastructure available in schools.

The resulting authentic assessment is very relevant to assist and support the implementation of learning using a scientific approach that prioritizes the procedures of scientific activities. Scientific approach is a learning approach that seeks to develop students' creativity and scientific attitude. The 2013 curriculum requires this scientific approach to build student competence through observing, questioning, trying, reasoning and communicating activities. The scientific approach in the scientific process is a way to study certain aspects of nature in an organized and systematic way [14]. The scientific approach is a systematic approach to obtaining a scientific conclusion. The scientific approach is also often called the inductive approach because in the process, the scientific approach starts from the specific to the general conclusion [16]. Retnonigrum stated that a scientific approach is believed to be a golden tool for the development of students' attitudes, knowledge, and skills [17]. Thus, learning with a scientific approach by using authentic assessment can be a solution for educational actors to encourage students to become competent and capable human resources in solving every competitive and sophisticated life issue in this era of globalization.

Teachers as implementers of education in the classroom should have the skills and expertise in designing appropriate assessments of the learning process and outcomes of their students. Teachers are required to understand various assessment techniques to collect authentic evidence of students' work. This is the evidence that will become a reference for teachers to provide feedback and follow-up to the next lesson. Students will be excited if each work is rewarded by teachers with the right value. This is one of the strengths of authentic assessment. Authentic assessment provides the space for teachers and students to collaborate on assessment. Marzano, Frontier, and Livingston explained that authentic assessment is an attempt to reflect on learning to see what components are not useful for improving student competence and providing new information for teachers to plan and prepare for further learning [9].

4. Conclusion
Based on the result and data analysis in this study, it can be concluded that: (1) analysis result for validity of authentic assessment is classified as valid by expert; (2) analysis result for practicality of teacher and student's response on authentic assessment is classified as very practical; (3) analysis result for effectiveness shows that more than 80% of students achieved the minimum score (KKM) for cognitive aspect. Meanwhile, more than 80% of students were classified as very satisfied as they passed the KKM for aspects of scientific attitude and science process skill. Hence, the developed authentic assessment that based on the scientific approach to improve students’ science process skill is valid, practical, and effective to be implemented in physics learning.
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