Process Skill Assessment Instrument: Innovation to measure student’s learning result holistically

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Abstract. Science process skills (SPS) are very important skills for students. However, the fact that SPS is not being main concern in the primary school learning is undeniable. This research aimed to develop a valid, practical, and effective assessment instrument to measure student’s SPS. Assessment instruments comprise of worksheet and test. This development research used one group pre-test post-test design. Data were obtained with validation, observation, and test method to investigate validity, practicality, and the effectiveness of the instruments. Results showed that the validity of assessment instruments is very valid, the reliability is categorized as reliable, student SPS activities have a high percentage, and there is significant improvement on student’s SPS score. It can be concluded that assessment instruments of SPS are valid, practical, and effective to be used to measure student’s SPS result.

1. Introduction
Science is defined as the nature and all phenomena that was encapsulated in a set of theories or concepts through a series of scientific process [1]. To perform the scientific process, it requires a certain amount of skill in science which was often called science process skills (SPS). SPS included observing, classifying, inferencing, predicting, looking for relationships, communicating, formulating hypotheses, performing experiments, controlling variables, and interpreting data [2]. SPS was a bridge to acquire and organize knowledge about environment and to link ideas that belong to students based on previous experience and new experience [3]. Science learning through SPS was expected to be a vehicle for students to learn about selves and natural surroundings, and further prospect of applying SPS in daily life [5]. Given the importance of SPS for students, SPS should be trained and pioneered through learning process in primary school.

In primary school, there were three domain: knowledge, attitudes, and skills, which should be implemented holistically to improve student’s comprehension. However, until the recent development, domain of knowledge still dominated as the benchmark in measuring students’ achievement [6]. Learning sciences was not always judged by using test assessment form to measure student’s understanding. Teacher should collect information about student comprehension by assessing all three domains to give more accurate information about student’s knowledge, skill and attitude. A set of variety assessment methods were needed to measure student’s science process skill and conceptual understanding holistically. Then it was essential to develop a set of assessment instrument which not only measured student’s material understanding but also student’s capability on SPS. The developed assessment instrument was based on Process Skills Approach (PSA). The material chosen in this instrument is the topic electricity as a medium to train SPS. Electricity chapter was chosen because
understanding electricity not only requires reading the descriptions of the material, but also doing investigation activities or experiments so that students can understand the material well.

To create a set of assessment instrument, understanding how assessments were made, what type of assessments answered what questions, and how the data from assessments can be used to help teachers, students, parents, and other stakeholders to make decisions about teaching and learning are required [8]. A good assessment instrument can be sort out from these following traits of validity and reliability. First, content validity means that the assessment measures what it was intended to be measured and nothing more. Second, reliability refered to the consistency of the assessment result. Consistency means student result was the same when they take the same test on different occasions and when different but equivalent tests are taken at the same time or at different times. And third, student engagement and motivation means an assessment instrument should persuade student’s interest.

There were several relevant research in developing an assessment instrumen for measuring student’s SPS. Monica [9] aimed to develop a reliable and convenient test for measuring integrated science process skills competence in high schools. Shahali [10] also did a research to develop a test instrument to measure student’s integrated SPS in Malaysia primary school. Temiz [11] developed multiple format instruments to measure both basic and integrated SPS to be applied in four high schools in Turkey. In contrast to the researches mentioned previously, Rosana [6] developed a non-test assessment instrument of science process skills. This non-test instrument was applied in high school also. Three of four previous researches developed instrument to assess Integrated SPS in high school. However, basic science process skills were important to be trained in primary school as well [12]. And it was only one of four researcher who developed a non-test instruments. A set of assessment instrument was essentially needed to assess student’s SPS thoroughly. This research aimed to develop a set of assessment instrument to measure basic science process skills of primary school students. The assessment instruments consisted of test and non-test instrument in order that student’s SPS result can be viewed from two sides fairly.

2. Research method
SPS assessment instrument was developed as a product which can measure the level of student’s SPS as whole. Assessment instruments in this research was developed using the 4-D model (four D model). There were four stages in the 4-D model, i.e. define, design, develop, and disseminate [13]. In this research, the stages which were done only up to the third stage, because the product was applied to a limited extent. One group pre-test post-test design was used in this research. Before learning process, student’s SPS was assessed to know initial level of student’s SPS. After treatment, teaching and learning activity using developed material, student’s SPS was assessed to know the level of student’s SPS after learning process. The research was carried out on Masangankulon Primary School in 2016/2017 academic year. Class used for research is V-D consisting of 25 students, 12 students were male and 13 were female students.

The data collected in this study were validity and reliability of assessment instrument, student’s SPS activity, and the student's SPS score. Table 1 conveys variables, data, instruments, and analysis of this study.

| Variables        | Data                        | Instrumen                      | Analysis                              |
|------------------|-----------------------------|--------------------------------|---------------------------------------|
| Validity         | Expert validation results   | Validation sheet               | Description of validity criteria      |
|                  | Readibility level           | Fry Graphic                    | (Ratumanan& Laurens, 2010).           |
| Practicality     | Percentage of student’s SPS activity | Observation sheet of student’s SPS activity | Description of student’s activity (Arikunto, 2010). |

Table 1. Data, instruments, and analysis.
3. Results and discussion

Assessment instrument consisted of worksheet, observation sheet of SPS activity, and test sheet. The instrument was tested to find out its validity, practicality, and effectivity. Validation results included examination, assessment, and advice from the validator. Table 2 conveys the validity and reliability of assessment instruments.

Table 2. Validity and reliability of assessment instruments.

| Instrument          | Validity | Reliability | Category                  |
|---------------------|----------|-------------|---------------------------|
| Worksheet           | 4        | 83%         | Very valid. Reliable.     |
| SPS observation sheet | 3       | 96%         | Valid. Very reliable.     |
| SPS test sheet      | 4        | 86%         | Very valid. Very reliable.|

Validating instruments needed to be done because it aimed to see if the instruments can be used by students or not [14]. Validation also aimed to find out the deficiencies of the instruments. With a valid instruments, teacher can conduct a good and fair assessment. Results of instruments validation indicated that the instruments is valid, reliable, and can be used with revision. The revision related to technical writing, i.e. fix a few typographical words. In addition, validator advised to add other experiment tool like plastic ruler or any other material as a comparison of static electricity symptoms.

Readability level of the instruments also determined its validity. Fry Graph was used to determine worksheets readability level. The main aspect in preparing learning materials was the linguistic aspect/readability [15]. Aspects of language/readability included: using Indonesia language according to Standardized Indonesian Language; the clarity of the language; and the easiness to read. Based on the coordinates (142.11) which were drawn on the Fry Graph, the assessment instruments was readable for fifth grade in primary school. It means that the worksheet can be read and understood by the fifth grade students. Readability level of the instruments determined learning achievement because if students understood the contents of worksheet, so it means that students can understood the learning material without the help of others.

The practicality of assessment instruments was viewed by observing student activities. Student activities which represented a non-test result were expressed by percentage. Observed activities regarding to SPS included observing, making hypotheses, calculating, experimenting, classifying, inferencing, and communicating. Graphic 1 shows the observation results of student’s activities.

![Graphic 1. Student's SPS activities](image)

Based on Graphic 1, activity which had the highest occurrence was observing, which achieve 24%. Observing had the highest occurrence because it was included into basic process skills. Observing is a response to various objects and events of nature using sensory perception [16]. Observing is often
done by students in daily life so the students do not have difficulty in implementing it. The lowest accuracy activity was making a hypothesis with an average percentage 9%. Making hypothesis had the lowest occurrence because students were still unfamiliar and have difficulty in making a hypothesis. Student did not fully comprehend the concept of hypothesis. Most of the students had the idea that a hypothesis is formulated after an experiment is conducted [17].

Next, the effectivity of assessment instruments was viewed from student’s test result. Students were given a SPS test sheet consist of 7 SPS problems: observing, making hypothesis, experimenting, counting, classifying, inferencing, and communicating. Table 3 conveys student’s test results.

| Science Process Skills   | Average of Score Gain | Category |
|--------------------------|-----------------------|----------|
| Observing                | 0.78                  | High     |
| Making hypothesis        | 0.63                  | Middle   |
| Experimenting            | 0.66                  | Middle   |
| Counting                 | 0.92                  | High     |
| Classifying              | 0.96                  | High     |
| Inferencing              | 0.65                  | Middle   |
| Communicating            | 0.88                  | High     |
| **Average**              | **0.78**              | **High** |

Based on Table 3, there were four SPS which get high gain score i.e., classifying, counting, communicating, and observing. It is proved that high percentage of SPS occurrence during learning process can affect student’s test result. When students performed certain process skill activities more often, students will master the skills in the process and improve their test result. It can be said that process skills approach focuses on engaging students actively and creatively in the study [2]. Four skills which had the highest activity percentage also reach a high gain score of test result. Based on the findings, we can measure knowledge domain by using SPS test result and skill domain by using observation sheet of SPS activity. As an impact, assessing student’s learning result can be done holistically, authentically, and fairly. This results confirmed that assessing SPS should be supported by a variety assessment methods in order to maximize student’s SPS improvement [18].

4. Conclusion
Learning science in primary school can not be judged in knowledge domain only, but also skills and attitudes domain. Thus, Student’s SPS needed to be assessed holistically by variety methods. The developed SPS assessment instrument consisted of test and non-test method. Non test method can be done by observing student’s activity while doing learning process and test method can be done by testing student with SPS problems. Based on results and discussion, it can be concluded: 1) SPS assessment instrument was valid and reliable according to validator judgement and readability level; 2) SPS observation sheets was practical to measure percentage of each SPS activity during learning process; 3) SPS test was effective to measure student’s improvement from pretest to post-test in SPS. The results also showed that SPS which had a high percentage of occurrence tended to have a high gain score. therefore, it was proven that skills and knowledge realm were related to one another.

Several recommendations can be given for further research: 1) before applying and measuring SPS, teacher should have fundamental understanding of SPS and how to introduce it to primary school students; 2) this research used electricity material as a media to apply SPS in primary school. Further research can use another material in science or any other subject as long as the topic not only required understanding the concept, but also practicing the skills; 3) SPS can be used along with any learning model to improve student’s comprehension.
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