Development of pendulum oscillation worksheets (POWs) to practice science process skills

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Abstract. This research aims to develop the task of science process skills on harmonic vibration material. Science process skills are important skills to be trained in students to contain various skills needed in the learning process to study natural phenomena. This research is part of the effort to develop instrument sets in the form of assignments and skills rubric of the science process research method used is the method of developing ACD (analysis, construction, and development), worksheets that are made then validated by experts and to obtain further development suggestions. The results show that the worksheets that have been developed are good with a note of improvement in the aspects of the task structure and statements on the worksheets to be made clearer and supplementary information is added related to the physical quantities.

1. Introduction
Scientific process skills are a usual of abilities reprocessed in directing scientific actions, creating and with scientific information, and problematic resolving [1]. SPS existed a connection to obtain and bring together knowledge about surroundings and to relation thinking that fit in to learners created on prior practice and different practice [2]. Basic skills remain the source for further composite integrated skills. Science process skills exist essential to the appliance. First, the improvement of skill is hurrying consequently that the situation is no extended potential for lecturers to explain realities and theories to learners. Second, the present is a propensity for learners to simply know multipart theories if attended by actual illustrations. Third, the finding is not entirely but is comparative, therefore it canister be disproved if someone becomes original facts that are competent to evidence faults [3]. Physics learning with science process skills is closely related to learning processes and products. The environment of physics such as a quantity of usual knowledge is now the dominion of practice and artifact. Practice and artifact have a corresponding significance near in physics teaching, mutually in knowledge and evaluating the outcomes of the education activities. Consuming thought that, examination then assessment wants to be effected in equally practice and artifact. The practice of learning physics remains regularly correlated to the abilities in acting out the household tasks of surveillance, measurement, investigate or practicum, data exploration, etc. Evaluating the learning actions need an apposite kind of impost, that remains, a performance impost which is able to look at students’ abilities [4].

That student should learn about what actual scientists do when designing and carrying out inquiries. One of the aims is to understand how knowledge about issues such as health and environment is obtained and validated [5]. Of course, learning and assessment cannot be separated, to determine student
achievement in teacher learning requires assessment. Developing students' abilities involves constructing assessment methods that take skills to support lecturers in their works and tell students' skills [6]. One way to practice this science process skills through assignments given to students, one form of an assignment to students is worksheets, worksheets that are developed for learning activities of pendulum oscillation material, in addition to that mini-research becomes material for development tasks and the rubric of process skills, while rubric produces rubric processes and rubric products.

2. Methods
The research method used is the development method, in this study carried out with several stages, namely analyzing, constructing and developing.

2.1 stage of analyzing
The initial stage in this research is the collection of information related to existing problems and development potential. This information gathering follows the process of learning science and the problems that arise in learning and discussion.

2.2 stage of constructing
The second stage in this research is determining skills and completing worksheets. The instrument that will be developed in this study consists of worksheets that are oriented to the scientific process. The science process skills that will be explored through this worksheet require integrated skills and skills that are adapted for oscillation material in the pendulum

2.3 stage of developing
The third step in this research is to make a list of specifications of the worksheets that were developed. Furthermore, this list is given to 5 experts to ask for input related to the worksheets that were developed, these results then become material for the improvement of the worksheets that have been made.

3. Result and Discussion
The results of the analysis in the first stage show the skills that show the skills that show the process that examines the phenomena, where there are two parts of skills, namely basic skills and integrated skills. There are four skills that will be drilled in the worksheet, namely observation, prediction, hypothesis and designing experiments.

3.1 worksheet

3.1.1 observation

Figure 1. Illustration images from observations made by students
Figure 1 shows an illustration of the observation process, the teacher initially demonstrates the pendulum motion with a certain length of rope then the demonstration is recorded and analyzed using a tracker application to get the pendulum motion analysis results. The observation is continued by changing the length of the rope that binds the pendulum, in this observation section students are expected to be able to have information that will be used in further activities.

3.1.2. prediction

![Graph prediction](image)

Figure 2. Illustration images from prediction made by students

Figure 2 shows an illustration of the task given to students to make predictions, predictions made based on their knowledge related to pendulum oscillation and the relation to the following equation:

\[ T = 2\pi \sqrt{\frac{l}{g}} \quad (1) \]

3.1.3 hypothesis

In this section the worksheet is designed so that students make hypotheses based on their knowledge, to make hypotheses students must be able to identify related variables. Mastery of the hypothesis concept, including understanding the concept of hypothesis and variable, is able to help students to explain and understand the effect one variable has over another, state the relationships between variables, gain the ability to formulate hypotheses, to differentiate a hypothetical statement from a non-hypothetical statement, and to determine whether a hypothesis can be tested to ascertain its plausibility[7]. Because the identification of variables is very important to make a hypothesis, in the process students must determine the independent variables, the dependent variable and the control variable.

3.1.4 designing experiment

At this stage students are given the task to design experiments by determining the research procedures, table of observations needed and the tools and materials needed. The composition of this task is based on the results of the analysis where to determine the tools and materials students must know in advance what variables will be observed and the process to be carried out in experiments to prove the hypothesis.

In addition, rubrics were also developed for answers from worksheets, where rubrics were made with only a scale of 0 and 1, because they assumed they wanted to construct further rubrics.
based on the answers of students who appeared who would later be developed to scale according to their needs.

3.2 validation
The instrument built was then tested to determine its suitability and included input related to the instrument being developed.

**Table 1. Suitability between the tasks and aspects of the skills to be trained**

| Skill     | Question / assignment | Assessment |
|-----------|-----------------------|------------|
| observation | A                     | 4          |
|           | B                     | 5          |
|           | C                     | 5          |
|           | D                     | 3          |
|           | E                     | 3          |
|           | F                     | 3          |
| prediction | G                     | 4          |
| hypothesis | H                     | 5          |
| designing experiments | I          | 5          |

The observation skills aspect consisted of six activities carried out by students, the results showed that in activities D, E and F there was only three raters who gave an assessment that the task was in accordance with the aspects of the skills to be trained. Observation skills have a greater portion assuming this activity becomes the basis for further activities. If students make observations and interpretations correctly, students should be able to predict [1]. For activities D, E and F according to expert one and expert two it is better not to be positioned in the observation activities and adjusted back to the learning conducted.

To conduct an assessment related to the worksheet that has been made, it is assessed by 5 experts with 3 experts relating to physical content and experts related to learning assessment and is also an experienced expert in developing worksheets.

**Table 2. Result of the assessment worksheet**

| Assessment     | Input                                                                 |
|----------------|----------------------------------------------------------------------|
| Expert 1       | Improve sentences on questions and worksheet statements so they are easy to understand |
|                | Reconstructed sequences in assignments on worksheets adapted to learning |
| Expert 2       | Complete the physical quantity information on the task in the worksheet |
| Expert 3       | Information on the worksheet is clarified so students can understand the instructions given |
| Expert 4       | Improve the sentence in the question and determine also the order of activities strived faster with a slow pace |
| Expert 5       | Clearer in the instructions and more contextual                       |

Validation results from experts related to the suitability of the activities with the aspects of skills as well as corrections and suggestions related to the development of worksheets.
Generally related to statements on worksheets that are not very clear, this certainly affects the students who will use the worksheets.

4. Conclusion
Based on the results and discussion, the worksheets developed that were oriented to the process skills on the pendulum oscillation material had good suitability, but with a note of improvement in the instructions sentences on the worksheet. This result will be used as material for the development of the Worksheets and Assessment rubrics.

5. References
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