Development of biology student worksheets to facilitate science process skills of student

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Abstract. This research aims to describe development of Biology student worksheets to facilitate science process skills of student, at the same time to facilitate thinking skills of students in senior high school are equipped with Assessment Sheets. The worksheets development refers to cycle which includes phase analysis (analysis), planning (planning), design (design), development (development), implementation (implementation), evaluation and revision (evaluation and revision). Phase evaluation and revision is an ongoing activity conducted in each phase of the development cycle. That is, after the evaluation of the results of these activities and make revisions at any phase, then continue to the next phase. Based on the test results for grade X, XI, and XII in St. Agnes Surabaya high school, obtained some important findings. The findings are as follows. (1) Developed biology student worksheets could be used to facilitate thinking ability of students in particular skills integrated process that includes components to formulate the problem, formulate hypotheses, determine the study variables, formulate an operational definition of variables, determine the steps in the research, planning data tables, organizing Data in the form of tables/charts, drawing conclusions, (2) Developed biology student worksheets could also facilitate the development of social interaction of students such as working together, listening/respect the opinions of others, assembling equipment and materials, discuss and share information and facilitate the upgrading of skills hands-on student activity. (3) Developed biology worksheets basically could be implemented with the guidance of the teacher step by step, especially for students who have never used a similar worksheet. Guidance at the beginning of this need, especially for worksheets that require special skills or understanding of specific concepts as a prerequisite, such as using a microscope, determine the heart rate, understand the mechanism of specific indicators.

1. Introduction
According to Lai [1], the necessary skills to face the challenges of the 21st century is the critical thinking skills to be able to analyze the problem objectively. Duran and Dökme [2] state that critical thinking skills students can be trained by inquiry-based learning. Inquiry learning in science related to the effort to understand the various natural phenomena systematically, which includes attitudes, processes, products, and applications of science. Associated with the process, the science regarding the troubleshooting procedures using the scientific method to discover the concept of science. Even at Indonesia National Standard confirms that learning process organized to motivate students to
participate actively in the learning process, and provide enough space for the creativity of the students [3].

Test TIMSS (Third International Mathematics and Science Study) indicates that the test measures five performance: (1) Understanding Simple Information, (2) Understanding complex information, (3) theorizing, Analyzing, and solving problems, (4) Using Tools, routine Procedures, and science processes, (5) Investigating the Natural World. Performance (2), (3), (4) and (5) it seems in line with the capabilities demanded in standard of competency above. It can be concluded that Indonesian students rank very low, it also means lower rankings in thinking ability so that it can be said also the competitiveness of Indonesian students in thinking the ability is also low.

This is supported by previous research results with a mapping exercise in one of senior high school in Surabaya Indonesia, showed that students' knowledge of process skills across school levels measured by the Science Process Skills Test relatively homogenous results are low. Based on these data can be interpreted that most likely from elementary, junior high and high school, students of this school has not yet obtained the maximum opportunity to learn science process skills. Or it can be said that science lessons in this school is not taught in their entirety. The students learn science as a product, not learn science as a process. This means that in this school, the science has not taught as products and processes. Master himself was also not mastered how to formulate an operational definition. Data skill experiment planning and formulation of low operational definition is a strong hint that during this experiment planning science in the classroom or in the laboratory carried out in a way that is not true [4].

Meanwhile, the results of the Test of Logical Thinking of students and teachers in this school showed that the majority of primary school students (66%) level of reasoning is concrete, while the junior high school students who think tangibly less (39%), high school students even fewer who think concrete (25%). Based on these facts can be interpreted to mean that the student, either elementary, junior high, or high school is not maximized in the chance to engage in logical-mathematical experience, or social experience, or do a hands-on activity. Although the results showed that teachers in this school has the potential to teach their students to reach the level of formal thinking. Considering only the teacher who has the ability formal logic which can plan and carry out the teaching and learning process based on formal logic. In addition to the teacher, this school has a very good learning atmosphere that is supported by infrastructure and good management at all levels, elementary, middle, and high school [4].

Based frameworks already explained, the purpose of this research is to develop tools of learning science, especially biology high school that can provide ease teachers to teach and students learn science and thinking skills that, in this particular case is that it teaches process skills in the subjects of biology in high school through student worksheets and student worksheets key, Assessment Sheet and Assessment Sheet keys that have been developed. The three principal components of the main aspects in the development of student worksheets in this study are aspects of mathematical logic, social interaction aspects, and aspects of the hands-on activity. Aspects of mathematical logic which may reflect the ability to think conceptually recall is defined as the ability to think logically, critically and creatively, the ability to analyze and solve problems that are components that exist in science process skills.

Students worksheet and assessment sheets were developed by adopting and adapting biological learning device used in developed countries. Expected Students worksheet and assessment sheets has a quality equivalent to the quality and Students worksheet and assessment sheets used in developed countries. Standard grain assessment of the assessment sheets and developed worksheets that refer to future education and conform with global standards. The strategy adopted for it is adapting or adopting a learning device owned by developed countries and their grains assessment contained in the reference cutting-edge science learning device developed countries. This strategy is pursued in an effort to fulfill the main requirement of reference benchmark grains, namely content validity. It's believed that student worksheet and grains assessment contained in the latest reference has been developed with standard procedures by the relevant experts.
2. Method
According to Fenrich [5] measures the development of these devices can be visualized as in Figure 1. The development cycle includes a phase analysis (analysis), planning (planning), design (design), development (development), implementation (implementation), evaluation and revision (evaluation and revision). Phase evaluation and revision is an ongoing activity conducted in each phase of the development cycle. That is, after the evaluation of the results of these activities and make revisions at any phase, then continue to the next phase.

In the phase analysis to identify the components of any process skills that must be mastered high school students, according to SK and KD content standards that exist in biology to be a learning tool developed is expected to be used in high school. While in the phased planning by planning format Student Worksheet and Assessment Sheet developed, as well as the necessary KIT designed to complete the worksheet. Meanwhile, in the phase design do drafting 1 Student Worksheet and assessment sheets are equipped with an instrument and key of Student Worksheet and Assessment Sheet. At this stage, it is also prepared KIT.

In the phase of development, the study conducted a draft 1 student worksheet, assessment sheet by expert reviewers and review of the operation of the equipment and materials KIT. Expert reviewers' suggestions and input for consideration to revise worksheets, and KIT assessment sheet to a draft 2 were prepared to investigate. At the time of testing in other senior high schools conducted a formative evaluation. Based on input from teachers and students, to revise the draft 2 student worksheet, and KIT assessment sheet to a draft 3 which is also the master worksheets, print-ready assessment sheet and KIT are ready for use.

![Cycle Model Development](image)

**Figure 1. Cycle Model Development [6].**

3. Results and Discussion
In this research, successfully developed 10 key of student worksheet and worksheets included, with 8 student worksheet tested. Accompanying for student worksheet, evaluation sheet was also developed for each of the keys along with the student worksheet and student sheet. On the development of student worksheet is also equipped with the KIT is a tool, materials, and infrastructure needed by students and teachers when using worksheets and assessment sheet are developed. The detailed results of the development of student worksheet as Table 1 include details of process skills component drilled on each worksheet.

Table 1 shows that the mapping component of process skills in general at 10 student worksheet developed, highly variable. This is in accordance with the characteristics of the materials developed by KI and KD. But in general, the process developed skills component is a component of integrated process skills that better facilitate students to perform the steps of the scientific method that is substituted with a concept tailored to KI and KD. This is expected to further provide a learning science (especially biology) intact from the three aspects of mathematical logic, the social aspect and the...
aspect of the hands-on activity. Considering the aspects of mathematical logic to reflect the ability to think to remember is conceptually defined as the ability to think logically, critically and creatively, the ability to analyze and solve problems, then the demands of the standard competency of Junior High School / High School will be met through learning to use worksheets that were developed which facilitates students to process skills science.

Table 2 shows a summary of the results of tests on eight point in student worksheet being investigated. Three aspects that were recorded during the tests which aspects of mathematical logic, social interaction aspects, and aspects of the hands-on activity. Generally indicates that to aspects of mathematical logic, at first, the students find it difficult when student worksheets was released without the guidance of a teacher. But when students are given the guidance of the teacher step by step in doing worksheets that require a coherent mind-set of students, students can complete worksheets well. The teacher's role is as a facilitator to provide a learning environment that allows students to be actively involved in learning as well as a guide to steer students on the tasks that will be done [6].

When done mentoring students working on worksheets given but still found some difficulties of students in terms of operationally defining variables of the study, planning procedures, interpret the data and make the data tables/graphs are correct by using the notation size of recognized standards. Social interactions showed quite good results considering the worksheets developed gives a chance to work in groups so that social interaction is to talk, ask questions, listen to the opinion of friends, give opinions, respect the opinion of friends, mutual trust, mutual cooperation can arise for students working on worksheets. In addition, it can be observed the joy and enthusiasm of students for doing worksheets, meaning that students in this student worksheet working with did not feel forced. Therefore, the worksheet test results show relatively good results, especially when students are asked to do the assessment. Rahman et al. [7] state that learning involves social interaction as a method of discussion to make students more active in the learning process and the students are able to process information received from the information rather than just listening to the teacher. In addition, Kruea-In et al (2015) stated that teaching and learning of science process skills are not only served as basic for the scientific method but also valuable opportunities for learning about the nature of science [8].
| No | Science Process Skills component | 01 | 02 | 03 | 04 | 05 | 06 | 07 | 08 | 09 | 10 |
|----|---------------------------------|----|----|----|----|----|----|----|----|----|----|
| 1  | Observations                    | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  |
| 2  | Scientific Figure               | ✓  |    |    |    |    |    |    |    |    |    |
| 3  | Problem                         | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  |
| 4  | Formulation of hypothesis       | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  |
| 5  | Controlling the variables       | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  |
| 6  | Planning                        | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  |
| 7  | Experiments                     | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  |
| 8  | Defining variables              | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  |
| 9  | Operations                      | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  |
| 10 | Conducting Experiments          | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  |
| 11 | Measuring and Counting          | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  |
| 12 | collection and Data Recording   | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  |
| 13 | Analyzing Data                  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  |
| 14 | Penginferensian                 | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  |
| 15 | Pemrediksian                    | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  |
| 16 | Making Tables or Graphs         | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  |
| 17 | Group Work                      | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  |

Worksheet 01: Seed germination CO2
Worksheet 02: plasmolysis cell
Worksheet 03: Photosynthesis Require Chlorophyll
Worksheet 04: Photosynthesis Require
Worksheet 05: Photosynthesis Need Light
Worksheet 06: Heart Rate
Worksheet 07: Growth
Worksheet 08: photosynthetic
Worksheet 09: ENZYME
Worksheet 10: Respiration
| No | Worksheet Number | Aspects of Mathematical logic | Aspects of Social | Hands-on activity |
|----|------------------|-------------------------------|-------------------|------------------|
| 1  | Biology Student Worksheet 01 | With the guidance and direction of the teacher of high school students can finish the task on student worksheet 01 very well, although initially they should be guided step-by-step. Despite the students' answers indicate several answers were less than perfect on the identification component variables, operationally variable formulate and determine the procedure | In doing student worksheet 01, students to interact socially as well. Because of this student worksheet facilitate social interaction such as cooperation, mutual help, and mutual respect, be a good listener, active and able to be responsible for helping the group complete the work on time. | At first, the students are less skilled in conducting. This is because students are not familiar with student worksheet given pattern. However, after being guided students can perform well. Student worksheet and KIT BIO 01 SMA gave students the opportunity to engage in hand on activity overall for all students involved in the design and execution of experiments. |
| 2  | Biology Student Worksheet 02 | Worksheet 2 were designed based on skill development in an integrated manner indicates that with the guidance and direction of teachers of high school students can finish the task on worksheet, although at first they should be guided step-by-step, especially in the use of the microscope as a prerequisite in the student worksheet this. But from the students' answers indicate several answers were less than perfect. | In doing these student worksheet, students interact well socially because this student worksheet facilitate the social interactions such as cooperation, mutual help, and mutual respect. | Obstacles in the student worksheet are demanding prerequisite that the students were able to use a microscope. Therefore, at first the students are less skilled in using the microscope, but after being given the guidance of students become more skilled. Students are also still difficult to distinguish between normal cells and cells that plasmolyzed and making incisions great epidermis so that the cells can be seen clearly. |
| 3  | Biology Student Worksheet 03 | LKS High School BIO 3 were designed based on skill development in an integrated manner indicates that with the guidance and direction of | In doing these student worksheet, students interact socially as well as worksheets facilitate social interaction such | Initially, students are yet to test their skillful starch. But with guidance, students more easily work on worksheets as the tools used in this student |
| No | Worksheet Number | Aspects of | Mathematical logic | Social | Hands-on activity |
|----|------------------|------------|--------------------|--------|------------------|
|    |                  |            | teachers of high school students can carry out student worksheet well, although at first they should be guided step-by-step, especially in a test for the presence of starch as a criterion in this student worksheet. This means that students are able to carry out the steps of the scientific method to prove that requires chlorophyll photosynthesis. Despite the students’ answers indicate several answers were less than perfect them being the conclusion, applying the results of experiments in explaining everyday phenomena, and interpret data. But in general, the students’ answers are still within reasonable limits. | as cooperation, mutual help, and mutual respect. | worksheet, students very familiar so they are quick to skillfully use the tools and materials are there to test their hypothesis. |
| 4  | Biology Student Worksheet 06 | BIO | In doing LKS High School 6 at first the students had difficulty when working on worksheets that demands skills determine/measure the heart rate by counting the pulse as a prerequisite in this LKS. Therefore we need the guidance and direction of the teacher. This means that it requires the guidance of teachers LKS gradually at first so that students are able to carry out the steps of the scientific method or scientific activities to prove the factors that affect heart rate. From the students' answers indicate several answers imperfect include the formulation of a hypothesis, identify variables, and write procedures. | In doing this student worksheet, student interact socially as well as worksheets are designed to facilitate social interactions such as cooperation, mutual help, and mutual respect. | Students during work on worksheets initially less skilled in using a stopwatch, and determine the location of the artery to calculate the heart rate, but after being given the guidance of the students become more adept at calculating the number of pulses in a specified unit of time. |
| No | Worksheet Number | Aspects of Mathematical logic | Aspects of Social | Aspects of Hands-on activity |
|----|------------------|-------------------------------|------------------|-----------------------------|
| 5  | Biology Student Worksheet 07 | Worksheet 7 is designed based on the development of skills in an integrated process. Student worksheet test results showed that in general beginning students find difficulty when working on worksheets that require thinking skills sequentially. However, because the BLM does not require complex skills, student worksheet can be followed easily by the students when they finish given guidance. This means that it requires the guidance of teachers LKS gradually at first so that students are able to carry out the steps of the scientific method or scientific activities. Despite the students' answers indicate several answers imperfect include the formulation of a hypothesis, identify variables, and write procedures. | In doing this student worksheet, student interact socially as well as worksheets facilitate social interaction such as cooperation, mutual help, and mutual respect. | At first, the students are not yet skilled measure the height of the root and trunk sprouted but after the guidance, students more easily work on worksheets are there to test their hypothesis. |
| 6  | Biology Student Worksheet 08 | Student worksheet trial results show that in general as well as worksheets-worksheets that other students initially find it difficult when working on worksheets that require thinking skills sequentially. These worksheets can be followed easily by the students when they finish given guidance. This means that it requires the guidance of teachers, student worksheet gradually at first so that students are able to carry out the steps of the scientific method or scientific activities with good conduct. This is evident from the analysis of the work carried out. | In doing this 08 BIO LKS High School students to interact socially is good for this student worksheet facilitate social interaction such as cooperation, mutual help, and mutual respect. Student worksheet was designed to work in groups. Students are a lot of discussions when planning research activities and analyzing the study data. | In the beginning, students lack the courage to write ideas at BIO LKS 08. This is expected because the students are not accustomed to taking steps and write down their ideas on the worksheet provided. However, after being guided students can perform well. student worksheet and KIT BIO 08 SMA gave students the opportunity to engage in hand on activity overall for all students involved in the design and execution of experiments. |
| No | Worksheet Number | Aspects of | Mathematical logic | Social | Hands-on activity |
|----|------------------|------------|--------------------|--------|------------------|
| 7  | Biology Student Worksheet 09 | | | | |
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For the aspects of the hands-on activity, student worksheet that was developed generally develop these skills. Therefore, students will experience obstacles in doing worksheet when basic skills in using certain tools as a prerequisite cannot be satisfied students. This is evident when students do worksheet 02, which requires students to use a microscope, as well as for worksheet 03-skill test starch, worksheet 06 demanding to determine pulse to calculate heart rate, worksheet 09-skill test starch with amylase of saliva and use the pipette correctly, and worksheet 10 which requires students to compose / assemble models simple respirometer. However, when teachers provide guidance gradually students can have a hands-on activity skills that can be improved so that the work can be done well. According to Ekwueme et al. [9], hands-on an approach where students are guided to learn from experience. The use of hands-on learning to be able to effectively teach a concept which is supported by other findings [10 - 12].

4. Conclusions and recommendations
Based on the test results of Biology Student Worksheet in High School for grade 10th, 11th, and 12th obtained some important findings which are also conclusion in this study. The findings are as follows.

4.1 Biology worksheet that have been developed in this study can be used to train thinking ability of students in particular skills integrated process that includes components to formulate the problem, formulate hypotheses, determine the study variables, formulate operational definitions of variables, determine the steps in the research, planning data table, organize Data in the form of a table / graph, drawing conclusions.

4.2 Biology worksheet developed also facilitate the development of social interaction of students such as working together, listening/respect the opinions of others, assembling equipment and materials, to discuss work procedures and share information and facilitate the improvement of skills of hands-on students' activity.

4.3 Biology worksheet developed basically be carried out with the guidance of teachers' notes with step by step, especially for students who have never had similar worksheets. Guidance at the beginning of this need, especially for worksheets that require special skills or understanding of specific concepts as a prerequisite, such as using a microscope, determine / measure the heart rate, understand how / mechanism specific indicators.

4.4 The use of integrated process skills worksheets substituted giving the meaning to study biology as a whole.
Based on the findings above anything that could be recommended by the researchers that the teaching skills of the process should not be separated from the subject of biology but should be based on activity. In order for the student activities directional, it is necessary to develop skill-oriented process with accordingly. In order for students, logical thinking skills honed then student worksheet presented must be loaded with science process skills through the guidance gradually when execution

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