# IMPLEMENTATION OF GUIDED INQURY LABORATORY WORKSHEET TO IMPROVE PROBLEM SOLVING SKILL

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**Abstract**

One of the way to improve students science competence is by applying inqury learning. Alternative levels of inquiry that can be applied into classroom is guided inquiry laboratory. Laboratory activity can improve process skill, scientific thinking, and problem solving. This research was conducted with aim to describe the validity and effectivity of guided inquiry laboratory worksheet in term of global warming material to improve problem solving skill. Before worksheet was implemented, the worksheet must be scored by validator. The worksheet is valid, if validator give good score in term of content and construct validity items. Worksheet is effective when the n-gain score greater than 0.3 and students giving a good response after worked their worksheet. This research is development research by using ADDIE model. The result of worksheet validation by two validator is very valid and it can be used in implementation phase. Worksheet was implemented to 31 student grade XI in SMA Negeri 1 Taman, Sidoarjo to know the effectivity. Pre-test and post-test score were obtained in implementation phase. Students performance was good while doing post-test. Students can reach every problem solving skill indicator after they worked on their worksheet. The average of student n-gain score is 0.77 and it categorized in high category. This result show that there was an improvement in student problem solving skill. Student responsee questionnaire was distributed at the end of learning process. Student responsee to worksheet shows the excecllent result. So, the guided inqury laboratory student worksheet to improve problem solving skill is effective.

**Keywords:** guided inquiry laboratory, worksheet, problem solving skill.

## INTRODUCTION

Improving the quality of education is always carried by the government, one of the things that can be done is by applying curriculum that suits the needs of human resources. The curriculum is enforced by the government as a guide in the learning process of each education unit (Kementerian Pendidikan dan Kebudayaan, 2017). The current curriculum in Indonesia is the Kurikulum 2013. The Kurikulum 2013 uses a scientific approach that includes observing, asking, trying, associating or analyzing, and communicating. Students are expected to be able to master the skills needed to compete globally in the 21st century by implementation of Kurikulum 2013, one of which is problem-solving skills (Fine, 2015).

The Indonesian index in the science literacy aspect of PISA (Program for International Student Assessment) 2012 is at a score of 382, which is far below the average OECD (Organization for Economic, Cooperation and Development) score of 580 (OECD, 2012). Problem-solving skills are part of the science literacy. Indomesian low scores on the science literacy aspect indicate Indonesian students low problem-solving skills (Saputri & Wilujeng,

2017). Teachers as important role holders in learning have various options for teaching Physics materials in order to help prepare students to become individuals with problem-solving skills. One of the way is, teachers can use laboratory activities to make students engage in learning. Students will become more active in learning, if supported by the other teaching materials used in laboratory activities such as worksheet.

Worksheet based on guided inquiry laboratory syntax can help students to be actively involved in learning. The advantage of the inquiry learning model is that students are given the opportunity to develop experimental designs, carry out experimental design and collect data. The data will be analyzed to find the relationship between variables. When stuudents encounter some difficulties, teachers are present to help solve these difficulties. But the responseibility for designing experiments, using technology to collect data, analyze and interpret data, and convey experimental results still held by students (Wenning, 2010).

In worksheet that is used in the guided inquiry laboratory learning model should include main

indicators of inquiry such as identifying problems, designing an experiment, conducting an experiment, using tools for an experiment, reviewing scientific explanations using scientific evidence, analyzing alternative explanations, and communicating scientific argumentation (National Researh Council, 2000). The advantage of guided inquiry laboratory worksheet is it can give students an opportunity to experience the full package of inquiry activity so it can help students to build their knowledge independently. It also conforms to the theory that science is not only a scientific product, but also a scientific process and a scientific attitude (Suciati & Hermita, 2016).

Worksheet which will be developed will be used by students as a guide to design their own laboratory activities. The content and construct validity of the developed worksheet must be fullfilled. Content validity is the conformity of worksheet content with learning process and Kurikulum 2013. Construct validity is the role of worksheet which is used to improve problem solving skill. The eligibility of content, language, and presentation must be met in the development of LKPD guided inquiry laboratory.

Polya (1957), who is the pioneer of the topic of problem solving, says there are four skills in the scope of problem solving skills, namely: (1) Problem definition, (2) Problem planning, (3) Plan execution, (4) Problem evaluation. These indicators then develop into learning indicators. There are understanding the problem, problem planning, plan executing, communicate the right conclusions, and formulate new ideas to examine other phenomena.

## METHOD

The research development of the ADDIE model for guided inquiry laboratory worksheet used in global warming material. The ADDIE model itself has five stages, which are analysis, design, development, implementation, and evaluation. The research subject for limited trial were students of class XI IPA 2 SMA Negeri 1 Taman, Sidoarjo which amounted to 31 students.

In the analysis phase, an analysis of needs analysis, task analysis, work analysis were done. At the planning phase, the stages of learning activities that will be conducted to achieve the learning objectives will be described. At the development phase, the draft of worksheet will be validated by the validators. At the implementation phase, the worksheet will be used in learning activities with pre-experimental one group pre-test-post test design study

method to determine the improvement of students' problem solving skills. At the evaluation phase, the students' pretest and posttest score, and the students responsees on the legibility and implementation of worksheet will be evaluated to determine the effectiveness of developed worksheet.

The research instruments that is used are validation sheet, student responsee questionnaire, developed worksheet, and test sheet. The data collection method that was conducted in the research is a questionnaire method and test methods. The collected data will be analyzed using validation sheet analysis techniques, test result analysis, and students responsee questionnaire analysis. The validation sheet uses a Likert's scale score such as Table 1.

**Table 1.** Likert's Scale Score

| Score Indicator | Scale Score |
|---|---|
| Very Valid | 4 |
| Valid | 3 |
| Invalid | 2 |
| Very Invalid | 1 |

Modified from: Sugiyono, 2017

The obtained score will be calculated its percentage using the formula as:

$$P = \frac{K}{n} \times 100\% \quad .......................... (1)$$

P is the obtained percentage, K is amounted score from two validators, n is maximum score in questionnaire. The obtained percentage will interpretated using a score interpretation criteria such in Table 2.

**Table 2.** Score Interpretation Citeria.

| Percentage | Criteria |
|---|---|
| 0%-20% | Very Invalid |
| 21%-40% | Invalid |
| 41%-60% | Valid Enough |
| 61%-80% | Valid/ Good |
| 81%-100% | Very Valid/ Excellent |

Modified from: Riduwan, 2012

The analysis of test result use n-gain index analysis. N-gain index used to conforms in what level the implemented worksheet that used by teacher was affecting promblem solving skill improvement. N-gain index formula is:

$$\langle g \rangle = \frac{s_{post} - s_{pre}}{s_{maks} - s_{pre}} \quad ................(2)$$

<g> is normalized gain, $s_{post}$ is post-test score, $s_{pre}$ is pre-test score, $s_{maks}$ is maximum score. Gain criteria according to Hake (1999) in Table 3.

**Table 3.** Normalized Gain Criteria.

| <g> | Criteria |
|---|---|
| $0,7 < (<g>)$ | High |
| $0,3 < (<g>) < 0,7$ | Medium |
| $0,3 < (<g>)$ | Low |

Questionnaire response analysis use questionnaire score recapitulation each item(s). Questionnaire response use Guttman's scale score such in Table 4.

**Tabele 4.** Guttman's scale score

| Answer | Score |
|--------|-------|
| Yes | 1 |
| No | 0 |

The obtaines score will be calculated its percentage use formula (1). Score interpretation from the response questionnaire percentage based on Table 2.

## RESULT AND DISCUSSION

This research is about worksheet development in guided inquiry laboratory learning model for improving students problem solving skill has been done with the use of ADDIE model (Analyze, Design, Development, Implementation, dan Evaluation). Research result(s) obtained from validation process in development phase and limited trial of worksheet in implementation phase. Validation has been done by two validators from lecturer of Physics Department, Unesa. First validator is lecturer that held the class of pedagogy and an author of IPBA handbook for students. Second validator is lecturer that held the class of pedagogy. Implementation phase has been done to 31 students of class XI IPA 2 SMA Negeri 1 Taman, Sidoarjo. Validation results in Fig. 1.
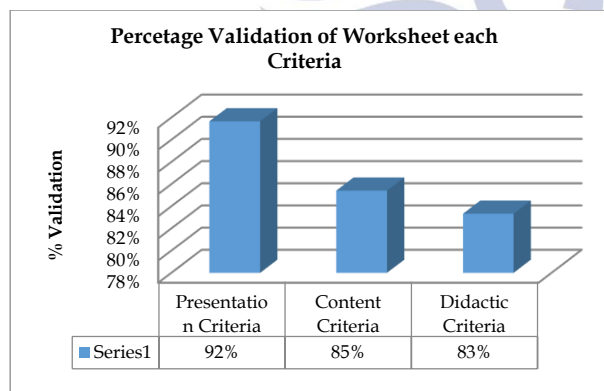


**Fig 1.** Validation Percentage each Criteria.

Validation aspect that include in presentation criteria are presentation order, coherence, numbering system, lay-out, and font (BSNP, 2014). Those aspects then developed into 6 questions that can be seen in Table 5. The average percentage that obtained from presentation criteria is 92% that can categorize as Very Valid.

**Table 5.** Validation Aspects

| Validation Criteria | Aspect each Criteria |
|---------------------|----------------------|
| Presentation Criteria | • Numbering system is clear.<br>• Layout setting<br>• Material prsentation to motivate student to learn independetly.<br>• Material presentation can engage setudents thinking.<br>• Worksheet presentation is interesting, fun, and not boring |
| Content Criteria | • Worksheet material fit with Kurikulum 2013.<br>• Worksheet material fit with basic competence and learning goals.<br>• Worksheet based on real experiment.<br>• Implementation of 5M in worksheet.<br>• Worksheet fit with guided inquiry laboratory learning model.<br>• Worksheet role is to improve problem solving skill. |
| Didactic Criterai | • Grammartically is correct.<br>• Sentence fit with the thinking level of students.<br>• Sentence structure is simple.<br>• Sentence not ambigu.<br>• Instruction and direction is clear.<br>• Language that is used in worksheet is communicative. |

Aspect(s) in content criteria fit with worksheet goal to convey the students to do an inquiry laboratory activity. Inquiry laboratory activity have a characteristics such as using a connected phenomena with the concept. So, the students can build their knowledge independently thorough that activity (Prastowo, 2015). Tha same thing also presented by Supriyono, et. al,. (2014) that students scientific competence can be improved effectively through the guided inquiry laboratory learning model. The average percentage of content criteria is 85% and it categorized as Very Valid.

Validated aspects in didactic criteria such as primary language, language is consistent, and communicative language (BSNP, 2014). That aspects then developed into 6 questions. The average percentage of didactic criteria is 83% that categorized as Very Valid.

After worksheet was rated Very Valid by the validator, then worksheet was used in the learning process in the limited trial phase. From the students score of pretest and posttest in the problem solving

skill indicator, it can be seen that the average of students n-gain score is 0.85 that categorized as high.

The lowest n-gain score obtained by the Student 17 is 0.46. At pretest, Student 17 do not answer all problem that contained the problem solving indicator. Problems answered by the Student 17 amounted 1 of 5 problem about problem solving skills indicator. At posttest, Student 17 answered almost all the problem, the full score was obtained by the Student 17 for the indicator to identify the information related to global warming, which at the time of the pretest Student 17 answered the problem on that indicator less precisely. Student 17 can identify the information that contained in the problem with their own language well in order to understand the problem.

The highest n-gain score was obtained by Student 13, Student 18, Student 19, Student 25, Student 26, and Student 29 was 1.00. At pretest Student 26 managed to answer all problems that contained problem solving skill indicators. The answers to the pretest given by the six students on some indicators are still incomplete and less precisely. At posttest, six students were able to answer all the problems by getting a full score. At pretest, six students was received the lowest score on indicators identifying information related to global warming.
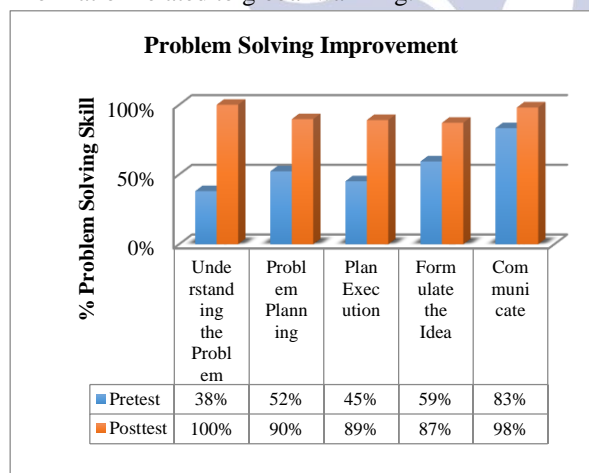


**Fig 2.** The Problem Solving Skill Improvement each Indicator

From Fig 2. it can be seen that among the five indicators of problem solving skills, the average percentage of indicator understanding the problems (38%) is the lowest among the other indicators. This is because the students are not accustomed in finding the main problem before doing a laboratorium activity. While the average percentage of indicator communicating the results of problem solving reached

83%. This is because studentss are accustomed to communicate results through presentation activities. Likewise, indicator problem planning, plan executing, and formulating ideas that get percentage less than 61%. Those average percentage were obtained before the students get treatment in the form of using developed worksheet in learning process.

After being given treatment in the form of using worksheet in learning, the average percentage of each problem solving skill indicator increases. In the learning process, the teacher always guides the students to perform step by step of guided inquiry laboratory well.

The result, the indicator of understand the problem experienced the most significant increase, it was reached 62%. Indicator of problem plan, plan execution, formulate the ideas, and communicate the result also increases. This is as stated by Prahani et.al., (2016) which concludes that Physics teaching materials that are taught using guided inquiry learning model are effective to improve the problem solving skills of students based on multiple representation.

Student response to worksheet is divided into two criteria. The first criterion is legibility and the second criterion is the implementation.
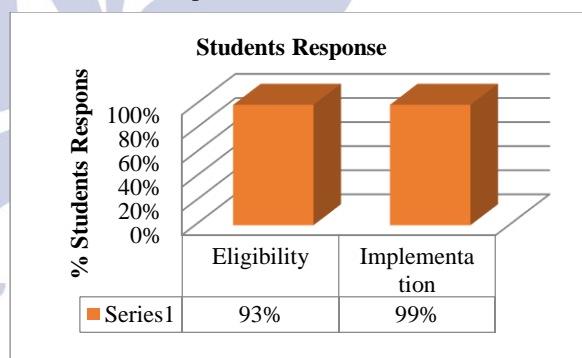


**Fig 3.** Percentage of Students Response

The average of students response is Excellent to developed worksheet on the criteria of legibility and implementation. In the legibility criteria, the lowest results is the clarity of questions and commands. It is also in line with the validation results on the didactic criteria which shows the aspect of language clarity also gets the lowest score by the validator.

On the implementation criteria, the lowest percentage is 97%, which is in the question about the pleasure of using worksheet as a learning resource. This is in accordance with a research conducted by Parappilly et.al., (2013) which concludes that many people are still unfamiliar and uncomfortable with

laboratory activities because there is so many things to be learned.

**CLOSING**

**Conclusion**

The developed worksheet on Global Warming material to improve problem solving skills is stated to be valid so that the worksheet is feasible to use and the developed worksheet categorized into effective category to improve problem solving skills because the acquisition of average of students n-gain categorized in high category also the students responsee to worksheet is excellent.

**Suggestion**

Research about the correlation of the students critical thinking skills with problem solving skills in Physics learning as well as the correlation of the students experimental skills with problem solving skills in Physics learning are needed. Laboratory activities on global warming materials also need to be evaluated in more depth in relation to other Physics concepts.

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