

THE DEVELOPMENT OF STUDENT WORKSHEET WITH INDUCTIVE STRATEGY ORIENTED ON ACID BASE MATERIAL TO IMPROVE STUDENT CRITICAL THINKING SKILL

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Abstract

This study was aimed to know the feasibility of student worksheet with inductive strategy oriented on acid base material to train student critical thinking skill. The feasibility was viewed according to theoretical and empirical feasibility. The empirical feasibility based on student response after using student worksheet with inductive strategy oriented on acid-base material developed. Theoretical feasibility is reviewed from the validation results. This research uses 4-D method, but only done until development stage (develop). Validation results shows percentage of content criteria is 83.33%, presenting criteria is 77.49% and 83.33% for language criteria. The results of student responses, the feasibility of student worksheet based on content criteria is 92.85%, 85% for presenting criteria and 97.5% for language criteria. Based on student responses and validation results can be conclude that student worksheet was very appropriate.

Keywords: students' worksheet, inductive strategy, critical thinking skill, acid base.

INTRODUCTION

According to Regulation of Education and Culture Minister (*Permendikbud*) No. 20 Year 2016 on Graduate Competency Standards (GCS) for high school states that a high school graduate must have the skills of thinking and acting creatively, productively, critically, independently, collaborative and communicative through scientific approach as development from being studied in educational units and other sources independently [1]. Critical thinking skills become one of the urgent skills that learners have to have [2]. Thus, critical thinking skills need to be taught to students to solve problems and train high-level skills.

One of the problems that happened in SMAN Balung is that the learning that the students receive only focus on the memorization of a series of topics or subject material, but not followed by a deep understanding. Many students of grade XI in SMAN Balung get grades under minimum score on acid-base material. This is caused by the way of teaching by teachers who still use the lecture method without involving the active role of students in learning, thus impacting the lack of understanding and critical thinking skills of students that impact on the low learning outcomes.

Based on the result of pre-study, the result of students' critical thinking skill is 38.33% in the interpretation aspect, 45% on the aspect of analysis and 40% on the inference aspect. The results are still relatively low, so it still need learning process that can improve students' critical thinking skills.

Acid base material especially on sub-material acid-base theory is considered to be a difficult material. Based on data of pre-research results, as many as 60% of students said that acid-base is a difficult material. Based on basic competence 3.10 students are required to be able to find a relationship and analyze the nature of the solution. In the acid base material is also common misconception that led to wrong concepts obtained by students and to achieve basic competence students needed critical thinking skills. Therefore it is necessary to develop a learning media that makes students can build a whole concept on submateri acid-base theory and can determine students' critical thinking skills.

Learning media is a medium that carries messages or information with instructional purpose or contains instructional purposes [3]. Learning media is a source of information in the form of printed materials / books, magazines, worksheets, and the like that can be used as a supporter of the learning process in presenting or absorbing subjects. The learning process is

essentially influenced by two factors, namely internal factors in the form of initial ability of students and external factors in the form of learning approaches. Learning approach can be done by using worksheet [4].

Student worksheet is one learning resource that can be developed by the teacher as a facilitator in learning activities [4]. Worksheet is also a learning medium, because it can be used together with learning resources or other learning media. Student worksheet can help teachers to direct teaching and introduce a particular activity as a learning activity. And with targeted learning can help students be more active in learning, so it can generate interest, foster self-trust and increase motivation to learn and curiosity.

One strategy that can be done and in accordance with the above problems is the development of student worksheet based on inductive strategy. Inductive strategies are also called learning strategies from the special to the public. In the inductive strategy the material being studied begins with concrete things or examples which are then gradually exposed to complex and difficult material. Inductive learning strategy is a direct but highly effective learning to help students develop high-level thinking skills and critical thinking skills. In direct inductive strategies provide presentations of information that will provide illustrations of topics to be learned by students, then the teacher guides students to find certain patterns from the illustrations given. This strategy can be applied to learning to achieve a defined competency. By using inductive learning students are expected to become more active in learning. The inductive approach begins with the giving of cases, facts, instances and causes that reflect a concept or principle. Then the students are led to strive to synthesize, announce, or summarize the basic principles of the lesson [5]. The learning process takes place naturally in the form of student activity work, thinking and experiencing, not just transfer of knowledge from teacher to student. Learning outcomes are expected to be more meaningful for students to solve problems, think critically, and carry out observations and draw conclusions in their long-term lives.

Based on the above description of the background, it is necessary an action through educational research. In this case, the authors raise a topic that is appropriate to the current conditions, namely: "THE DEVELOPMENT OF STUDENT WORKSHEET WITH INDUCTIVE STRATEGY ORIENTED ON ACID BASE

MATERIAL TO IMPROVE STUDENTS CRITICAL THINKING SKILLS".

METHOD

The research of students' worksheet oriented by inductive strategy has been development refers to the method of development of the four-D method proposed by Thiagarajan, Semmel, and Semmel [6]. The 4-D development model consists of four stages: Define, Design, Development, and Disseminate. Implementation of development in this research only to the stage of development (Develop), because this research is done only to determine the feasibility.

The analysis model that used in this research is as follows:

1. Review Analysis

This review data was obtained from chemistry lecturer and chemistry teacher. The study was conducted in draft I to get suggestions and inputs from chemistry teacher and chemistry lecturer related to criteria of feasibility of student worksheet.

2. Validation Analysis

The validation data on student worksheet developed was analyzed by using quantitative descriptive model. This analysis used in each of the criteria contained in the validation sheet. Percentage of data was obtained using Likert scale in Table 1.

Table 1 Likert Scale

Category	Value Scale
Very appropriate	4
appropriate	3
Enough appropriate	2
Less appropriate	1
Not appropriate	0

A score of 0 is given if the criteria given are not in the developed worksheet.

The data obtained then calculated by using the formula:

$$\% = \frac{\text{total score of collecting data}}{\text{scoring criteria}} \times 100$$

with description:

Criteria score = highest score x number of questions x number of respondents.

The results of the validation sheet analysis is used to determine the feasibility of student worksheet using Likert interpretation scored as follows in Table 2:

Table 2 Interpreting score

Value Scale	Category
0%-20%	Not appropriate

Value Scale	Category
25%-40%	Less appropriate
41%-60%	Enough appropriate
61%-80%	Appropriate
81%-100%	Very appropriate

[7]

Analysis of validation sheet is performed against three criteria: content, presenting and language. Based on the Likert scale score interpretation, student worksheet are feasible if the percentage $\geq 61\%$ or in good or appropriate criteria. So the student worksheet are feasible to used for teaching and learning process.

3. Students Responses

Data about student response was obtained from student response questionnaire after using student worksheet then analyzed by percentage and concluded in the form of descriptive sentence. Percentage of data was obtained using Guttman's scoring scale calculation, ie scored 1 if yes and score 0 otherwise. Questionnaires for students, made in the form of "yes" or "no as follow in Table 3.

Tabel 3 Guttman Scale

Answer	Score
Yes	1
No	0

[8]

Then, the percentage calculation used formula below:

$$P(\%) = \frac{F}{N} \times 100\%$$

Where:

P = response answer

F = total "yes" answer

N = total respondents

Based on Table 2, student worksheet is feasible empirically if percentage that obtained $\geq 61\%$.

4. Test Sheet Analysis

Analysis of this test sheet to know the knowledge and critical thinking skills of students to support the data from the responses questionnaire that is by knowing the mastery of students' critical thinking skills after using the developed student worksheet. Critical thinking skills of students are analyzed using a range of competence values of knowledge. Improving students' critical thinking skills in the pretest and posttest stages is determined through an n-gain score. The formula for determining the n-gain score is as follows:

$$g = \frac{\text{score posttest} - \text{score pretest}}{\text{score maximum} - \text{score pretest}}$$

Furthermore, the n-gain score criteria (which) are shown in Table 4 below:

Tabel 4 Gain Score

Score	Criteria
$g > 0.7$	High
$0.7 > g > 0.3$	Medium
$g < 0.3$	Low

[8]

5. Observation Sheet of Student Activity

Analysis of this observation sheet is used to know the observation result of student activity done by an observer and will get the dominant activity. The questionnaire compiled by the researcher refers to the Guttman scale expressed in terms of "Yes" and "No" answers.

RESULTS AND DISCUSSIONS

Theoretical Feasibility

Theoretical feasibility is the known feasibility of the validation sheet analysis on the developed student worksheet which is reviewed from the content, presentation and language criteria. Validation is done by a team of experts consisting of two Chemistry lecturers and one Chemistry teacher. Validation is reviewed from content, presentation and language criteria of student worksheet based on inductive strategies developed. Data validation results are analyzed descriptively quantitative is presented in Table 5.

Table 5. Validation Result

No	Criteria	Percentage	Category
1	Content	83.33%	Very Appropriate
2	Presentation	77.49%	Appropriate
3	Language	83.33%	Very Appropriate

1. Content Criteria

Aspects assessed by chemistry lecturers and chemistry teachers on validation of inductive content-based content criteria on acid-base materi to train students' critical thinking skills developed are the suitability of student worksheet with Core Competence, Basic Competence, issues raised according to level Cognition of students, has a clear purpose and useful as a source of motivation, and organizing the material follow the systematic science, the suitability of student worksheet with inductive strategy stages, and the suitability of worksheet with critical skills skills component.

2. Presentation Criteria

The next aspect assessed by the chemistry lecturer and chemistry teacher is the validation of the presentation criteria of the student worksheet based on inductive strategies on acid-base material to train students' critical thinking skills.

3. Language Criteria

The next aspect assessed by the chemistry lecturer and chemistry teacher on student worksheet. Language validation based on the inductive strategy on acidic base material to train students' critical thinking skill developed is student worksheet suitability with good and correct Indonesian language and in accordance with *EYD*, the language used according to the level maturity of students, the use of clear sentence structure and the use of communicative language.

Empirical Feasibility

Empirical feasibility is the feasibility of being reviewed based on the results of student responses and the results of students' thinking skills tests after using the developed student worksheet.

1. Student Response

Results of student responses obtained from students' opinions on student worksheet based on inductive strategies obtained through the questionnaire of student response. The result of questionnaires responded to students who answered "yes" on every aspect. Results of student responses are presented in Table 6.

Table 6. Student Responses

No	Criteria	Percentage	Category
1	Content	92.85%	Very Appropriate
2	Presentation	85%	Very Appropriate
3	Language	97.5%	Very Appropriate

Based on the result of student response to student worksheet with inductive strategy contained in Table 6 shows that all aspect get percentage $\geq 61\%$ with category very respond. Questionnaire student response consists of 16 items statement. The statements 1-7 are statements that support the content criteria which generally earn a percentage of $\geq 85\%$. Based on the interpretation of Likert scale scores in Table 2, students strongly respond to the student worksheet content criteria developed. Students argue that the questions and explanations in the student worksheet are easy to understand because they are presented in a trace, the problems presented according to their level of development. Based on the results of these responses can be concluded

student worksheet developed easy to understand so that it can help students in studying acid-base material. It shows that the developed student worksheet can make students understand a concept so that students will be able to build the concept intact. It proves that the language used is in accordance with the language criteria component. This is supported by the results of knowledge tests and critical thinking skills tests of students as it shows that students are relatively improved after using student worksheet based on inductive strategies.

CLOSURE

Conclusion

Based on the correspondence between the results and the aims, it can be concluded that:

1. Based on the theoretical feasibility examined from the validation results consisting of content, presentation, and student worksheet criteria based on an inductive strategy on acid-base material to train students' critical thinking skills developed eligible for use. It is based on validation results where the percentage of contents criteria is 83.33%; Presentation criteria 77.49%; and the language criteria 83.33%.
2. Based on empirical feasibility in terms of responses and test results of critical thinking skills indicate student worksheet with inductive strategy on acid-base material to train students' critical thinking skills eligible for use. It is based on the results of student responses that indicate that students are very responsive to student worksheet developed with percentage of each aspect $\geq 61\%$. It is also supported by the results of critical thinking skills tests showed that students have excellent critical thinking skills and each component of critical thinking skills gets a percentage of $\geq 61\%$.

Suggestion

1. The development of student worksheet based on inductive strategy on acid-base material to train students' critical thinking skill in this research is only done until development stage so that the next research is expected to be done until dissemination stage.
2. Pretest and posttest sheets provided earlier and after using student worksheet with inductive strategies on acidic base material to train critical thinking skills
3. Students should have the same indicators but different questions.

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