



# Guided Inquiry-Based Worksheet Development to Improve Critical Thinking Skills on Colloidal Properties Sub Material

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**Abstract: Guided Inquiry-Based Worksheet Development to Improve Critical Thinking Skills on Colloidal Properties Sub Material.** According to the background of the problem obtained in the pre-research. So this study was conducted to find out the feasibility of a guided inquiry-based worksheet to boost critical thinking skills on colloidal properties sub material. There are three aspects to determine the developed worksheet's feasibility: validity, practicality, and effectiveness. This research utilizes a Research & Development (R&D). The limited trial was tested on 15 class XII MIPA 6 at State High School 3 Sidoarjo. The research result indicates that the developed worksheet is valid in content validity, a percentage of 90%, and construct validity of 84%. Moreover, all of them got a very valid category. Practicality gets an average student response of 79%, and participant observation students by 79% overall got the practical category. Effectiveness is obtained according to the *pre-test and post-test* results of critical thinking skills, with an *n-gain* score of 0.521-0.938 in the medium to high criteria.

Keywords: Worksheet feasibility, guided inquiry, critical thinking skills, colloidal properties.

Abstrak: Pengembangan LKPD Berbasis Inkuiri Terbimbing untuk Meningkatkan Keterampilan Berpikir Kritis pada Sub Materi Sifat Koloid. Menurut latar belakang masalah yang didapat pada pra-penelitian. Maka penelitian ini dilakukan guna mengetahui kelayakan dari LKPD berbasis inkuiri terbimbing untuk meningkatkan keterampilan berpikir kritis pada submateri sifat koloid. Terdapat tiga segi untuk mengetahui kelayakan LKPD yang dikembangkan yaitu kevalidan, kepraktisan, dan keefektifan. Dalam penelitian ini menggunakan Research and Development (R&D). Uji coba terbatas diujikan kepada 15 peserta didik kelas XII MIPA 6 SMA Negeri 3 Sidoarjo. Hasil penelitian mengindikasikan bahwasannya pengembangan LKPD bersifat valid dilihat dari kevalidan berupa validitas isi mendapat 90% serta validitas konstruk sebesar 84%. Keseluruhan mendapat kategori sangat valid. Kepraktisan mendapat hasil rata-rata respon peserta didik senilai 79% serta observasi rutinitas peserta didik senilai 79%, keseluruhan mendapat kategori praktis. Keefektifan didapatkan dari hasil pre-test dan post-test keterampilan berpikir kritis, dengan skor n-gain pada rentang 0,521-0,938 dalam kriteria sedang hingga tinggi.

Kata kunci: Kelayakan LKPD, inkuiri terbimbing, kemampuan berpikir kritis, sifat koloid

# • INTRODUCTION

Education is part of the determinant of the success of national development. As for educational goals include developing abilities and producing character and the civilization of a dignified nation in a framework for children to educate the nation, develop the potential of students, so that Be a man of faith and piety to God Almighty (Sari, 2017). Chemistry is the knowledge acquired initially and developed inductively based on experiments, but its development. Chemistry is also developed deductively based on theory. Chemistry lessons in high school / MA teach everything about a substance, including the composition, structure, nature, change, dynamics, and substance energetics involving skills and reasoning (SMA, 2014). Chemistry is one subject that is very important for participants educate because it can develop critical thinking and act creatively, productively, and communicate (Abdurrahman, 2003). Curriculum 2013 is a curriculum that demands students to implement an active role in the studying process because, in this curriculum, learning focuses on students (student-centered). The teacher acts as a facilitator or intermediary and learning designer so that students are actively seeking new knowledge (Putri & Mitarlis, 2015). Chemistry learning and assessment of learning outcomes chemistry must take note of the characteristics of science chemistry as a method and a product. Because of that, chemistry learning aims to provide a concept and theory and can spread critical thinking skills in students. Therefore, teaching materials are needed in the learning process to increase interest and critical thinking in student learning. Wrong teaching materials applied in school the other is the student worksheet (Sani, 2013).

Learning strategy design is needed to be utilized in studies to improve students' critical thinking skills education. Learning using guided inquiry is a strategy that makes students learn independently to develop critical thinking skills by utilizing the concept discovery process. The concept innovation process will be better if learning is guided using the activity steps contained in the worksheet (Sularso, 2015). The worksheet is not only in the form of tasks that students must do, but also there is a learning approach to help students find a concept and develop students' critical thinking skills. Thus, the worksheet utilizes a guided inquiry-based approach to help boost students' critical thinking skills.

The impact of learning guided inquiry is a significant outcome on the critical thinking skills of participants educate. The impact of learning guided inquiry can be realized if the teacher's arrangement well structures learning with an approach to learning before the learning process takes place. One is learning with a guided inquiry approach (Mushrafa, 2016). A wrong chemistry learning approach the other can be related to the phenomenon of daily life, which is the guided inquiry approach, students are given initial problems and directed on a discussion. Learners learn more based on the guidance and instructions of the teacher so that students can understand the concepts of the subject matter and improve problem-solving skills (Meidiawati, 2014). Through participant activity learning in the discovery of chemical concepts (sub material of colloidal properties) found from an experimental process will be more meaningful learning and critical thinking skills students can be adequately facilitated. The reasoning is essential for the ability critical thinking of each student towards problem-solving because reasoning is part of critical thinking, where if the reasoning good students, the students' critical mind students can be said to be good too (Widyoko, 2012). One of the concepts in chemistry learning that

requires a thoughts process to understand the application of that concept themselves in students' daily lives is the colloid concept (Fajariyah, 2015).

After completing the pre-research, it can be observed that 92% of class students XII MIPA 6 at State High School 3 Sidoarjo states that colloids are a matter which there is no calculation is only full of the draft. 79% of students expect to learn about colloidal material, especially the colloidal properties accompanied by a practicum, not only contains self-study and assignment. The questionnaire results also show that 50% of students do not know the actual application of the concept learned at school. That matters due to the learning carried out in school on colloidal material, especially sub materials properties of colloids are self-study and assignments without the guidance of the teacher. Monotonous learning, as above, causes low thinking ability critical of students. Based on the literature described and the facts on the ground according to the questionnaire results, it can be developed worksheet according to guided inquiry to boost critical thinking skills on colloidal properties sub material.

# • METHOD

This research is categorized as development research. The method utilized in this development is *Research and Development* (R&D) (Sugiyono, 2015). The R&D research method has the following steps: (1) Identification of potential and problems, (2) Literature study and data collection, (3) Product design, (4) Product design review and revision, (5) Product design validation, (6) Product design revision, (7) Product trial. In this study, the data sources will be obtained from the opinions of chemistry lecturers, chemistry teachers, with 15 students of class XII MIPA 6 at State High School 3 Sidoarjo on the worksheet developed. Expert lecturers guide and provide input by filling out study sheets. The next step is that three validators consisting of 2 chemistry academics and 1 chemistry teacher present an assessment score of 1-4 on the validation sheet. Content with construct validity can be utilized to assess the validity of the developed worksheet. To calculate the validity of the worksheet, you can use the formula:

$$Validity = \frac{\sum Overall \ Score}{\sum Criteria \ Score} \ge 100\%$$

 $\sum Criteria \ Score =$  "the max score of each aspect x amount of aspects x number of validators".

The percentage of validity scores was obtained by using Likert scale calculations. Results obtained from the assessment of the score of the validity results interpreted using validity criteria and development as in Table 1 with the percentage of worksheet developed is said to be valid if it reaches the minimally valid category.

Table 1. Score Interpretation Category		
Percentage%	Category	
0-20	Invalid	
21 - 40	Less	
41 - 60	Enough	
61 - 80	Valid	
81 - 100	Very Valid	
	(D'1	

(Riduwan, 2015)

According to the interpretation score category, if the content validity and construct validity aspects get  $\geq 61\%$ , the worksheet developed is labeled as valid. (Riduwan, 2015).

The next step for the worksheet is produced, executed limited trials to 15 students of class XII MIPA 6 at State High School 3 Sidoarjo. The trial stage was carried out to determine the developed worksheet's effectiveness and practicality. The practicality of the developed worksheet could be known from the percentage of response questionnaires and observation of student activities during the trial limited in progress. Result presentation response questionnaire and participant activity observation students can be determined using calculations Guttman scale score using the formula:

$$P = \frac{F}{N} x \ 100\%$$

The percentage of the questionnaire responses and observations of student activities are interpreted according to the categories listed in Table 1. According to the interpretation criteria score category, the worksheet developed can be practical when you get a presentation  $\geq 61\%$ , which is categorized as valid (Riduwan, 2015).

Improvements in the assessment of critical thinking skills in each student can determine the effectiveness of the developed worksheet. The results of the assessments of critical thinking skills could be calculated applying the n-gain score calculation. Before counting, *N-gain* score data are normalized first using the Kolmogorov Smirnov Test on SPSS. The equation to determine the value of the index is written as follows:

$$N-Gain = \frac{Posttest \ Score - Pretest \ Score}{Maximum \ Score(100) - Pretest \ Score}$$
(Hake, 1998)

According to the *N*-gain score obtained, the worksheet is claimed effective if each student gets an *N*-gain score of  $0.7 > g \ge 0.3$  with medium category or  $g \ge 0.7$  with high category.

### • RESULTS AND DISCUSSION

This part will explain the results based on the studies that have been done to generate some data regarding the feasibility worksheet, including: validity, practicality, and effectiveness.

#### Worksheet Validity

Validation aims to determine the results from 2 chemistry lecturer validators and 1 chemistry teacher validator on the feasibility of the worksheet developed. Worksheet validity includes two criteria, namely content validity and validity construct. The percentage of content validity is obtained from the assessment results that the three validators have carried out is then interpreted according to Table 1. The data from the validation results are written in Table 2 as follows:

	Table 2.	vandation result	uata
No.	Assessed Validity	%	Category
1.	Contents	90	Very Valid
2.	Constructs	84	Very Valid

Table ? Walidation manult data

Content validity got a percentage result of 90%, to be categorized as very valid. There are 4 components in content validity: conformity with the material, the suitability of the material with critical thinking skills, worksheet conformity with guided inquiry, and worksheet conformity with critical thinking skills. There are three construct validity

components: the suitability of the worksheet with the language criteria, worksheet suitability with criteria relating to presentation, and the suitability of the developed worksheet related to graphic got an average percentage of 84% with the graphic very valid category. The preparation process worksheet was adjusted to the guideline's preparation of teaching materials for the Ministry of National Education in 2008 if the development of teaching materials should be paying attention to the linguistic component, presentation component (Depdiknas, 2008).

The worksheet developed was declared valid, according to the results of the average percentage between content validity and construct validity reaching 84% which had met the eligibility criteria because it obtained a percentage on all aspects of  $\geq 61\%$  and was categorized as very valid.

### **Worksheet Practicality**

Practicality can be seen according to the percentage of response questionnaires and activity observation sheets. Response questionnaires were distributed and filled out by students after learning to get the results of the questionnaire percentages, while the student activity observation sheets were distributed and filled out by three observers during the studying process to get the results of the activity observation percentages. Based on the response data, students get a percentage of 79% in the practical category. Data results of observing student activities on each learning using a worksheet developed are indicated in Table 3.

Table 3. Results of observing student activities					
No	Aspect	Percentage	Category		
1.	Observation of student activity	84%	Very		
	in meeting 1		Practical		
2.	Observation of student activity	73%	Practical		
	in meeting 2				

The data in the Table 3 above indicates that the activities of students observed during the worksheet trials at meetings 1 and 2 got an average percentage of 79%, which was categorized as practical. Based on the data from the percentage of student response questionnaires and observations of student activities, the worksheet developed was declared feasible practicality because the response questionnaire results and observation of each student activity were  $\geq 61\%$ .

# **Worksheet Effectiveness**

Each student's test results can determine the effectiveness of the developed worksheet. Two test are tested to test students' critical thinking skills: *pretest*, which is tested before learning using the developed worksheet, and *posttest*, which is tested after learning using the developed worksheet. Student's critical thinking skills are improved according to students' pre-test and post-test scores calculated using the n-gain score. Before being calculated utilizing *n*-gain, the data from the *pre-test* and *post-test* were normalized utilizing the Kolmogorov Smirnov test on SPSS to ensure that the study's obtained data were normally distributed or not. The normality of the pre-test and post-test data are in Table 4.

Table 4. Data normality test				
Aspect	Ν	α	Asymp. Sig (2 tailed)	Category
Pretest	15	0,05	84%	Normal
Posttest	15	0,05	73%	Normal

Table 4 above indicates that the students' pre-test and post-test results are generally distributed because of the Asymp results. *Sig (2 tailed)*>0.05. Then, the *pre-test and post-test* data were calculated utilizing the *n-gain* score. The *n-gain* score of students' critical thinking skills is according to the *pre-test* and *post-test* scores obtained in Table 5.

Table 5. N-gain score results				
No	Pre	Post	N-gain	Category
1.	31	80	0,710	High
2.	43	83	0,701	High
3.	40	86	0,766	High
4.	26	83	0,770	High
5.	49	78	0,568	Medium
6.	43	94	0,894	High
7.	35	83	0,738	High
8.	35	75	0,615	Medium
9.	38	80	0,677	Medium
10.	29	66	0,521	Medium
11.	51	97	0,938	High
12.	40	80	0,666	Medium
13.	31	69	0,550	Medium
14.	40	80	0,666	Medium
15.	40	80	0,666	Medium

It can be seen in Table 5 above that as many as seven students, or 46.67%, the *n*-gain value obtained is in the high category, and eight students, or 53.33%, the *n*-gain value obtained is in the high category so that it could be seen that the guided inquiry-based worksheet could boost critical thinking skills as seen from the increase in critical thinking skills test results. Previous research, it was stated that STEM-based guided inquiry was effective in improving students' critical thinking skills. It could be seen from the results of the n-gain score of students' critical thinking skills that there is an increase and is in the high category (Isdianti, Nasrudin, & Erman, 2021). According to other studies, it is asserted that in the critical thinking skills test, there are significant results after and before the guided inquiry learning model of blended learning is conducted. The value of the n-gain score in this study is included in the high category (Saekawati & Nasrudin, 2021).

According to the data, shows that the worksheet is declared feasible. The worksheet developed is effective if it gets an *n*-gain of  $0.7 > g \ge 0.3$  in the medium category or  $g \ge 0.7$  in the high category. In this study, the worksheet developed obtained an *n*-gain score of 0.521-0.938, categorized in the medium to high category.

### • CONCLUSION

From the analysis and discussion of data from research on the development worksheet, it can be concluded that validity got categorized as very valid overall at content validity results are 90 %, and construct validity is 84%. In terms of practicality, it also got the practical category, based on the average student response is 79%, and

student observation is 79%. And the last term of effectiveness is categorized in the medium to the high category, according to increasing *pre-test* and *post-test* critical thinking skills obtain a score *n*-gain from 0.521 to 0.938.

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