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Development of Inquiry Student Worksheet Through Internet Assisted Learning to Train Science Process Skills

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Abstract: Development of Inquiry Student Worksheet through Internet Assisted Learning to Train Science Process Skills. The research objective is to determine the feasibility of inquiry Students' Worksheet (LKPD) through internet assisted learning in order to train the students about science process skills. The research uses a 4-D development design (Define, Design, Develop, Disseminate), but it was not carried out until the disseminate stage. However, the trial was limited to 12 students of XI MIA 4 SMAN 15 Surabaya who had not received material on reaction rates. The instruments used are consisted of review sheets, validation, students' response questionnaires, tests (pretest and posttest) science process skills and students' knowledge tests. The results shows that the Students' Worksheet which developed is feasible to use based on the acquisition of a validation value ≥61% and the value obtained by ≥80 according to the school's minimum completeness criteria (KKM). The percentage of results of content criteria validation got 92%, conformity with the guided inquiry method get 93%, conformity with the component of science process skills got 97%, presentation got 93%, language got 93%, and graphics got 90% with very valid categories in terms of theoretical and empirical validity. Supported by positive student responses. The results of the knowledge test obtained the n-gain score by 0.98 in the high category. The percentage value of the science process skills test which includes the components of formulating problems, formulating hypotheses, identifying variables, collecting data, analyzing data and making conclusions respectively are 100%, 96%, 98%, 100%, 94%, and 96% with very high categories.

Keywords: Student Worksheets, Inquiry, Internet Assisted Learning, Science Process Skills.

Abstrak: Pengembangan LKPD Inkuiri melalui Pembelajaran Berbantuan Internet untuk Melatih Keterampilan Proses Sains. Tujuan penelitian adalah untuk mengetahui kelayakan Lembar Kerja Siswa (LKPD) inkuiri melalui pembelajaran berbantuan internet untuk melatih keterampilan proses sains siswa. Penelitian ini menggunakan desain pengembangan 4 dimensi (Define, Design, Develop, Disseminate), namun tidak dilakukan sampai tahap diseminasi. Namun uji coba dibatasi pada 12 siswa kelas XI MIA 4 SMAN 15 Surabaya yang belum mendapatkan materi tentang laju reaksi. Instrumen yang digunakan terdiri dari lembar telaah, validasi, angket respon siswa, tes (pretest dan posttest) keterampilan proses sains, dan tes pengetahuan siswa. Hasil penelitian menunjukkan bahwa LKS yang dikembangkan layak untuk digunakan berdasarkan perolehan nilai validasi ≥61% dan diperoleh nilai ≥80 sesuai kriteria ketuntasan minimal sekolah (KKM). Persentase hasil validasi kriteria isi 92%, kesesuaian dengan metode inkuiri terbimbing 93%, kesesuaian dengan komponen keterampilan proses sains mendapat 97%, presentasi 93%, bahasa 93%, dan grafik 90% dengan kategori yang sangat valid dalam hal

validitas teoretis dan empiris. Didukung dengan respon siswa yang positif. Hasil tes pengetahuan diperoleh skor n-gain sebesar 0,98 dengan kategori tinggi. Nilai persentase tes keterampilan proses sains yang meliputi komponen merumuskan masalah, merumuskan hipotesis, mengidentifikasi variabel, mengumpulkan data, menganalisis data, dan membuat kesimpulan masing-masing adalah 100%, 96%, 98%, 100%, 94%, dan 96 % dengan kategori sangat tinggi.

Kata Kunci: Lembar Kerja Siswa, Inkuiri, Pembelajaran Berbantuan Internet, Keterampilan Proses Sains.

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• INTRODUCTION

Chemistry is a part of natural science that is obtained and developed based on experiments to study natural phenomena which are then organized into concepts, theories, and laws. Chemistry learning in the 2013 curriculum requires a match between the material being taught with experiences or examples that exist in everyday life through direct experimentation. Chemistry learning is expected not only to provide knowledge to students, but also to be able to stimulate thinking, to be scientific and creative as well as responsibility by realizing its impact on the environment and trying to find solutions so that it can preserve the surrounding environment (Hasnah & Gani, 2016).

In accordance with the 2013 curriculum that is currently used, the basic competencies that students must achieve in the material reaction rate in research are 3.4 Explaining the factors that affect the reaction rate using collision theory and 4.5 Designing, conducting, and concluding and presenting the experimental results of the factors which affects the rate of reaction and reaction order (Kemendikbud, 2020). From these basic competencies, it can be seen that the reaction rate material not only emphasizes mastery of concepts, but also requires proof through experiments by means of students observing, analyzing and concluding themselves based on the data obtained. Therefore, the two basic competencies are related to each other because the results found from basic competencies 4.5 are used to explain and support the achievement of basic competencies 3.4.

However, considering the condition is still in a pandemic period which requires distance learning (online). As a Mathematics and Natural Sciences teacher, especially Chemistry, you must be faced with various obstacles, especially when learning cannot be done face-to-face (Offline) and the limitations of manual practicum tools and the lack of time efficiency that must be managed properly in doing practicum which makes students difficult to imagine how to do practicum procedure. In accordance with Holme's research (2020) which states that the main problem of learning chemistry is the delivery of learning using the laboratory. Through Internet Assisted Learning virtual laboratories such as practical demonstration videos accessed via a link or barcode can be a solution to these various problems. Because in addition to being easy to use, providing immediate and fast access to Web content, it can also be downloaded and utilized offline via an available link or barcode, even the steps involved in carrying out the procedure are clearly exemplified. This is consistent with research by Yonata (2009) which shows that internet-assisted

learning on the subject of factors affecting reaction rates can increase activity, positive responses, and completeness of learning outcomes. Benedict and Pence (2012), the results of a study conducted showed that it was easier for students to visualize complex problems or procedures when they saw videos that demonstrated the process.

Based on the results of interviews with chemistry teachers at SMAN 15 Surabaya, it was found that chemistry learning had started to apply several components of science process skills, but most other chemistry teachers were rarely applied. Thus, the response of students tends to be slow and low when faced with new material that applies these skills. In line with Sofya's (2019) research that low science process skills can interfere with the implementation of teaching and learning activities and students' understanding of other chemical materials.

According to Germann, et al (1996) the most significant way to develop students' science process skills is by holding an experiment. When someone has mastered process skills, that person has been able to master high-level learning skills including solving problems and conducting experiments. The ability to solve problems and a research is a skill in life (life skill), because it includes high-level learning outcomes (Semiawan, 1992).

Science process skills can be trained in the learning process using an appropriate learning model, namely the inquiry or discovery learning model. The inquiry learning model applied in this study is the guided inquiry learning model according to Arends (2012). Guided inquiry is an alternative learning model that is suitable for correcting deficiencies in the field in order to improve science process skills (KPS). In the inquiry learning model, students are encouraged to identify what they want to know and continue by looking for information themselves, then the information obtained is organized or constructed through knowledge and understanding in its final form. Guided inquiry learning model was chosen because in its application using teaching materials students are not just let go, but also still get guidance from the teacher. Therefore, teaching materials are needed in accordance with the current learning model in order to achieve the specified completeness of the competencies.

One of the teaching materials that can be used and developed in accordance with the current situation and conditions of learning activities to facilitate students to acquire concepts independently during teaching and learning activities is the Student Worksheet (LKPD). The Ministry of National Education states that Students' Worksheet is one of the teaching materials that can be used as a guide in teaching and learning activities because it contains exercises and tasks that must be done by students in certain studies. Students are expected to be trained in science process skills through the use of relevant Students' Worksheet. This is reinforced by research conducted by Anggraeni that learning using the developed Students' Worksheet, then the ability of science process skills of students can be trained accompanied by a positive response from students.

Based on the background of the problem above, the researcher needs to carry out a study entitled "Development of Inquiry Students Worksheet through Internet Assisted Learning to Train Science Process Skills".

- **METHOD**

The research instruments used in the study included study sheets, validation sheets, student response questionnaires supported by student activity observation sheets, science process skills test sheets, and knowledge test sheets.

The results of a study conducted by a lecturer in the Department of Chemistry at the Faculty of Mathematics and Natural Sciences Unesa were in the form of suggestions aimed at improving the developed Students' Worksheets and analyzed descriptively. While the results of the developed Students' Worksheet validation were carried out by one chemistry lecturer of Faculty of Math and Science Unesa and two chemistry teacher from, Senior High School 15 Surabaya and Senior High School 2 Lamongan which were then analyzed using quantitative descriptive methods through percentage calculations. The percentage is obtained by comparing the scores from the data collection of all validators divided by the maximum score in order to obtain the percentage and criteria score of the assessment is carried out by calculating the Likert scale which is presented in Table 1.

Table 1. Likert Scale

Statement	Score
Invalid	1
Less valid	2
Quite valid	3
Valid	4
Very valid	5

Then the Likert scale calculation data is calculated using the following percentage formula:

$$\% = \frac{\text{Total Score}}{\text{Mak score}} \text{ X } 100\%$$

Score criteria = highest score x number of aspects x number of respondents. The percentage results obtained are interpreted into the score criteria in Table 2:

Table 2. Criteria for Percentage of Assessment

Percentage (%)	Category
0-20	Invalid
21-40	Less Valid
41-60	Quite Valid
61-80	Valid
81-100	Very valid

The validation of the student worksheet (LKPD) that was developed is said to have met the content criteria, conformity with the guided inquiry method, conformity with science process skills, presentation, language and graphics if a percentage of ≥ 61% is obtained with valid or very valid criteria.

The results of the student response questionnaire were supported by student activity observation sheets. Student response questionnaires were analyzed based on the scores obtained from positive and negative questions measured using the Guttman scale which is presented in Table 3.

Table 3. Guttman Scale

Students' Responses	Score
Yes	1
No	0

The percentage result of the Guttman scale data is calculated using the formula:

$$\% = \frac{\text{Total Score}}{\text{Mak score}} \text{ X } 100\%$$

The results of the participant response questionnaire analysis were used to determine the practicality level of the Students' Worksheet developed using the interpretation of scores in Table 4. Students' Worksheet was declared practical if the percentage obtained was ≥ 61%.

Table 4. Interpretation of Response Scores

Percentage (%)	Category
0-20	Not responding
21-40	Less respond
41-60	Quite Respon
61-80	Respond
81-100	Very Good Responding

The results of observations of student activities were analyzed descriptively quantitatively which was then used to support the student response questionnaire. The percentage of each student's activity is calculated using the formula:

$$\% = \frac{\text{The number of students who participated}}{\text{Number of students}} \text{ X } 100\%$$

While the learning outcomes of the knowledge test are calculated using the formula:

$$\text{learning outcomes} = \frac{\text{Score obtained}}{\text{Mak score}} \text{ X } 100\%$$

The results of the pretest and posttest individually were analyzed using the calculation of the n-gain score. And the average difference between pretest and posttest is calculated using the formula:

$$Ngain = \frac{\text{Posttest Score} - \text{Pretest Score}}{\text{Max Score} - \text{Pretest Score}} \; x \; 100\%$$

The n-gain score obtained is interpreted in Table 5.

Table 5. Criteria N-gain Score

Score	Criteria
(<g>) ≥ 0,7	High
0,3 ≤ (<g>) ≥ 0,7	Average
(<g>) < 0,3	Low

Students are said to have mastered the material if a learning outcome score is ≥80 in accordance with the school's minimum completeness criteria (KKM). The results of the assessment of the components of science process skills which include formulating problems, formulating hypotheses, identifying variables, collecting data, analyzing data

and concluding are analyzed descriptively. Each component is calculated using the formula:

$$Ngain = \frac{\text{Posttest Score} - \text{Pretest Score}}{\text{Max Score} - \text{Pretest Score}}\ x\ 100\%$$

The n-gain score obtained is interpreted in Table 6.

Table 6. Interpretation of Scores

Percentage (%)	Category
0-20	Very low
21-40	Low
41-60	Normal
61-80	High
81-100	Very high

The results of the analysis of the science process skills test for each individual were analyzed using the n-gain score or the difference between the pretest and posttest averages calculated using the formula:

$$Ngain = \frac{\text{Posttest Score} - \text{Pretest Score}}{\text{Max Score} - \text{Pretest Score}}\ x\ 100\%$$

Students master the skills of science skills, if they get a learning outcome value ≥80 according to the Minimum Completeness Criteria (KKM).

- **RESULT AND DISCUSSION**

The research with the title "Development of Inquiry Students' Worksheet through Internet Assisted Learning to Train Science Process Skills" aims to produce and develop Students' Worksheet that are suitable for students to use. The feasibility of this Students' Worksheet is viewed from its theoretical and empirical validity. Theoretical validity consists of content and construct validity. Content validity includes content criteria, suitability with guided inquiry methods, and conformity with science process skills components. Meanwhile, construct validity consists of presentation, language, and graphic criteria. The empirical validity in terms of students' responses to the Students' Worksheet, the results of the science process skills test and the test results of learning in the domain of knowledge were tested on 12 students with the intention of obtaining data on the developed Students' Worksheet.

Validity of Student Worksheets

The results of the validation were carried out by one lecturer in the Department of Chemistry, Faculty of Mathematics and Natural Sciences Unesa and two high school chemistry teachers. One chemistry teacher at Senior High School 15 Surabaya and one chemistry teacher at Senior High School 2 Lamongan are students' worksheet validity data in terms of content and construct validity which includes content criteria, suitability with guided inquiry methods, and conformity with components of science process skills. Meanwhile, construct validity consists of presentation, language, and graphic criteria. The

empirical validity in terms of students 'responses to students' worksheets, the results of science process skills tests and the test results of learning in the domain of knowledge were tried out on 12 students. Students' worksheets developed are said to be valid if they get a percentage value for each criterion ≥ 61% (Sugiyono, 2012).

Table 7. Data Validation Results

Rating Criteria	Average Percentage	Category
Content	92%	Very Valid
Guided Inquiry Methods	93%	Very Valid
Science Process Skills	97%	Very Valid
Presentation	93%	Very Valid
Language	93%	Very Valid
Graphics	90%	Very Valid

From Table 7., the validity of the contents of the students' worksheet being developed gets a percentage value of 92%. According to BSNP, this value is categorized as very valid because with these results it can be interpreted that the content validity is in accordance with the material and Competency Standards (SK), Basic Competence (KD), as well as the learning objectives to be achieved (BSNP, 2010).

The validity of the suitability with the guided inquiry method obtained a percentage of 93% with a very valid category. High school students are included in levels 9-12, the inkuri approach that corresponds to that level is guided inquiry, so that all guided inquiry syntax is listed in the developed Students' Worksheet (Kuhlthau et al, 2007).

The validity of the suitability of the Students' Worksheet developed with science process skills which includes components of formulating problems, compiling hypotheses, and identifying variables, collecting data, analyzing data and making conclusions to obtain a percentage of 97% with a very valid category. This is because all components of the science process skills that are trained are contained in the students' worksheet being developed. In addition, some guided inquiry syntax is also found in science process skills so that the two aspects are interrelated (Castro and Morales, 2017).

Linguistic validity gets a percentage value of 93% with a very valid category. Language is an important aspect because when language can be loaded properly, students with the age range 16-18 years will find it easier to understand information and learning materials because knowledge is built and constructed together (John W. Santrock, 2008). The results of the student response questionnaire also stated that the writing of the Students' Worksheet was developed using easy-to-understand terms with a percentage of 100%.

The validity of the presentation gets the percentage value of 93%. This value is categorized as very valid because the presentation of the sequence of concepts and exercises in the Students' Worksheet is presented systematically and clearly.

The validity of the graphic gets the percentage value of 90% with a very valid category. Graphic aspects such as an attractive cover, use of standard fonts (type and size), suitability of the background with the color of the writing, text layout, pictures and tables are harmonious and the terms used in the Students' Worksheet are quite simple to make it easier for readers (Depdiknas, 2008).

From table 7, it is known that the criteria for science process skills get the highest percentage value, which is 97% in the very valid category. Meanwhile, those who get the lowest percentage value are the criteria for the graphic with a percentage of 90% or are

called very valid. The evaluation of the validator is carried out subjectively and in different instances so as to obtain different validation results according to each validator's point of view.

Practicality of Students' Worksheets

Practicality for the Students' Worksheet developed in terms of student response questionnaires and the results of observations of student activities. The results of the student response questionnaire will be presented in Table 8 below:

Table 8. Student Response Questionnaire Results

No	Rated aspect	Percentage	Category	
1	The descriptions or explanations in the Students' Worksheet are easy to understand	100%	Very responding	Good
2	The Students' Worksheet questions are easy to understand	100%	Very responding	Good
3	Students' worksheets can train to design problem solving according to phenomena	100%	Very responding	Good
4	Presentation of Students' Worksheet trains the skills to do experiments	100%	Very responding	Good
5	Videos on the Students' Worksheet make it easier to describe the experiment	100%	Very responding	Good
6	llustrations or drawings of Students' Worksheets help understand concepts	92%	Very responding	Good
7	The students' worksheet presentation is interesting or fun	100%	Very responding	Good
8	Students' worksheets can be trained to formulate problems and hypotheses based on phenomena	100%	Very responding	Good
9	Students' worksheets can be trained to make conclusions from the experiments you are doing?	100%	Very responding	Good
10	Students' Worksheet fosters curiosity about the material to be discussed	92%	Very Responding	Good

Based on table 8, it can be seen that the respondents agree with all aspects of the assessment contained in the Students' Worksheet developed that have met the criteria of practicality because in each aspect the percentage of results is ≥ 61%, which is in the range 92% -100% with the very respond category. This means that descriptions or explanations, questions and videos contained in the Students 'Worksheet are easy to understand and foster students' curiosity so that students will more easily accept the material to be discussed. Video is an alternative mapping that helps students learn at their own pace because it provides an instructor tool that visualizes the learning steps through the YouTube channel (Ranga, 2017).

The percentage results that get the lowest score are in the 6th and 10th aspects, namely illustrations or pictures of Students 'Worksheets helping to understand the concept and Students' Worksheets fostering curiosity about the material to be discussed with the percentage of results obtained by 92%. This is because learning is not carried out face-to-face, causing low motivation of students to learn before learning.

The Effectiveness of Student Worksheets

The test method used to measure the increase in students' science process skills was the pretest and posttest. With this test, researchers can find out the science process skills and

understanding of students before and after using the Students' Worksheet which was developed on the sub-material of the factors that affect the reaction rate. Students work on the pretest and posttest questions on the same question as many as 6 essay items with the time given for 20 minutes. Pretest questions were given to students before using the developed Students 'Worksheet, while posttest questions were given after using the developed Students' Worksheet. The data obtained was the result of students' learning science process skills. Students are said to be trained in science process skills if they reach a value of ≥80. The results of the posttest students will be presented in Table 9 below:

Table 9. Posttest Result Data

Number	Components	Total Score	Criteria
1	Formulation of the problem	100%	Very high
2	Hypothesis	96%	Very high
3	Variable Identification	98%	Very high
4	Presentation of Data	100%	Very high
5	Data analysis	94%	Very high
6	Conclusion	96%	Very high

Based on the results of the pretest obtained, there are still many students who experience incompleteness in answering questions that are in accordance with the components of science process skills. This is because there is no learning and science process skills are rarely trained before working on the pretest questions. While the results of the posttest science process skills of students on average all completed with the lowest score of 88 and the criteria for n-gain score in the high category. This means that the ability of students after learning to use Inquiry Worksheets through Internet Assisted Learning to Train Science Process Skills in Reaction Rate Material is in accordance with the component of science process skills which includes formulating problems, compiling hypotheses, identifying variables, collecting and analyzing data to make conclusions. This shows that the value obtained is greater than Anggraeni and Hidayah's research (2019) because the Students' Worksheet developed includes Science Process Skills and Internet Assisted Learning (Internet Assisted Learning). Science Process Skills (KPS) are all scientific skills that are very important in the science learning process because learning activities are well directed (cognitive and psychomotor), so they can be used to find concepts, principles and theories in order to develop scientific concepts and attitudes that have been there before (Indrawati, 1999).

Internet assisted learning is a guide or way for students to find and access information via available internet links (Hamamoto and Kagawa, 1998). One of the basic competencies used in research is KD 4.5 and current learning which requires distance (online), so that to achieve KD, students can access and watch experimental videos via a website address or available internet link. Therefore the percentage of completeness of learning outcomes for 12 students is 100% because students can answer the questions contained in the Students' Worksheet according to the video without the need to do experiments. In accordance with Smith (2014) that experiments recorded on video and shared on social media websites will have a positive impact in stimulating the intrinsic

motivation of students' understanding. However, if there are students who do not understand, they can do the experiment themselves at home because the tools and materials used in the experiment are quite simple and have been clearly presented in the students' Worksheet or by viewing the video via the link provided.

- **CONCLUSION**

Based on the suitability of the research data and the formulation of the problem, it can be concluded that the Inquiry Students' Worksheet through Internet Assisted Learning to Train Science Process Skills is feasible to use which is viewed from the validity of the content and construct with a very valid category. Practicality criteria are also fulfilled indicated by the results of a very positive percentage of student response questionnaires and activity observation sheets carried out. While the effectiveness of LKPD also meets the effectiveness criteria, which is indicated by the learning outcomes of science process skills and knowledge of students who get a high category n-gain score.

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