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THE DEVELOPMENT OF EXPERIMENT WORKSHEET WIHTIN INQUIRY ORIENTATION TO EXERCISE HIGHER ORDER THINKING SKILLS IN FACTORS THAT AFFECTING REACTION RATE TOPIC OF 11th GRADE' SENIOR HIGH SCHOOLSTUDENT

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Abstract

This study aims are to know the feasibility of Experiment Worksheet within Inquiry Orientation to Exercise Higher Order Thinking Skills that had been developed as a learning media on factors that affecting reaction rate topic. The research method that used was 4-D method (define, design, develop, and desseminate). But this research was conducted until develop step only, namely development. This worksheet had been reviewed and validated by 2 chemistry lecturers and a chemistry teacher.Then it has been tested on 12 students in11th grade of Bahauddin Senior High School Taman Sidoarjo.The result of this research showed that this Worksheet had been developed is feasible tobe used as learning media. This was shown based on the assessment result from chemistrylecturers and teacher, viewed from teoretical validity including content criteria, presentation criteria, inquiri orientation criteria, and higher order thinking skill criteria, each of that percentage was 93,20%, 90,67%, 86,86% and 93,41%. While empirical validity was student responses which supported by student activities including content criteria, presentation criteria, inquiri orientation criteria, and higher order thinking skill criteria, each of that percentage was 99,31%, 89,41%, 83,33% and 93,75%. Result of higher order thinking skill test by overall is 83,33%.
Keyword: *Inquiry orientation worksheet, higher order thingking skill, factors that affecting reaction rate.*

Abstrak

Penelitian ini bertujuan untuk mengetahui kelayakan LKS eksperimen bersorientasi inkuiri untuk melatihkan berpikir tingkat tinggi yang dikembangkan sebagai media pembelajaran pada materi faktor-faktor yang mempengaruhi laju reaksi. Metode penelitian yang digunakan adalah metode 4-D (define, design, develop, dan desseminate). Namun pada penelitian ini hanya terbatas sampai tahap develop saja yaitu pengembangan. LKS ini ditelaah oleh 2 dosen kimia dan 1 guru kimia dan juga divalidasi oleh 2 dosen kimia dan 1 guru kimia. LKS ini diujicobakan pada 12 orang siswa kelas XI SMA Bahauddin Taman Sidoarjo. Hasil penelitian menunjukkan bahwa LKS yang dikembangkan ini telah layak digunakan sebagai media pembelajaran. Persentase hasil penilaian dosen kimia dan guru kimia, yang ditinjau dari validitas teoritis dalam criteria isi, criteria penyajian, criteria berorientasi inkuiri, dan criteria keterampilan berpikir tingkat tinggi yang memperoleh presentase berturut-turut sebesar 93,20%, 90,67%, 86,86% dan 93,41%. Sedangkan validitas empiris yaitu respon siswa yang didukung oleh hasil aktivitas siswa dalam kriteria isi, criteria penyajian, criteria berorientasi inkuiri, dan criteria keterampilan berpikir tingkat tinggi mendapat hasil sangat layak dengan persentase berturut-turut sebesar 99,31%, 89,41%, 83,33% dan 93,75%. Padahasil dari tes keterampilan berpikir tingkat tinggi secara keseluruhan adalah 83,33%.
Kata Kunci: *LKS berorientasi inkuiri, keterampilan berpkir tingkat tinggi, faktor-faktor yang mempengaruhi laju reaksi*

INTRODUCTION

Education have important role because education is an instrument for improving and developing quality of humans resources. With the education development that more advanced makes educational institutions to be able to adaptof science development. Many of special attention are directed fordevelopment and education advancement to improveeducation quality. Therefore, increasing education quality is necessary because today, welfare ofnation is not only sourceinnatural resources and capital that physicaly but also derived fromresources ofintellectual capital, social capital, and trust.[1]

One of method that performed to improveeducation quality is reformeducational system. The educational system that currently implemented is curriculum2013.Curriculum 2013 aims to prepareIndonesianpeople to have capability to live as personal and citizen who religious, productive, creative, innovative, and affective also able to contribute to society, nation, state, and world civilization. [2]

Flexibility in this curriculum reserved to teacher because teacher is considered more understanding of students condition, so the way to students achievement competition is teacher authority to creativity through devices learning, teaching approaches, learning strategies, teaching method or devices evaluation.At science,students are not only learn themselves and environment, but also prospect development furthermore apply in daily life.The learning process emphasizes providing direct experience to develop competencies that students are able to explore and understand the universe around scientifically.

One of science field study of matter and energy in terms of the properties, reactions, structure, composition, and energy change accompanying the reaction is chemistry. Chemistry is the study of the universe in which the concepts are based on observations and experiments in the laboratory.

One of the materials contained in chemistry in senior high school are learning the material factors that affect the rate of reaction. In the chemical process are factors that affect the rate of reaction among other influences reagent concentration, temperature, surface area, and the catalyst for the reaction rate. Implementation of learning in school is still considered difficult material by students. Based on the questionnaire distributed to 25 students of 11^{th}grade of Sience in MA Bahauddin Taman Sidoarjo, found that 28% are interested in learning chemistry, 72% of students' difficulties with the material factors that affect the rate of reaction, 76% of students stated learning material factors that affect the rate of reaction carried out with learning in the classroom and doing practical work. In chemistry teaching students already used worksheets. However worksheet used only at a low level thinking, was not finished using the approach that trains students to think critically. Due to the worksheets that are used by students not making such inquiry components formulate the problem based on the phenomenon that occurs, formulate hypotheses, analyzing variables experiment, plan and execute experiments, making observations and collecting data, analyzing the data, conclude experiments, and find the concept, so that students are not active and creative in chemistry learning in the classroom. While the worksheets in the market contain only practice questions only, not using the method of inquiry and not train students to think critically. And also worksheet on previous research that are in the Reading Room Department of Chemistry, State University of Surabaya already used method of inquiry, but not to train high-level thinking skills of students.

Material reaction rate is the subject matter of learning in the delivery of chemical easy but hard to be understood by the students. Most of the students'

difficulties in the material factors that affect the rate of reaction describeabout understanding the reaction rate by doing experiments. Because at the time of the experiment requires skill. Skills process is one of them with solving problems in an experiment. This experiment was conducted to determine the effect of reactant concentration, temperature, surface area, and the catalyst for the reaction rate. If seen from the purpose of teaching and students' lack of understanding of the material factors that affect the rate of reaction is then directed to approach the learning process skills is one of them using Worksheet.

Worksheet is sheets that contained tasks must be done by learners. The tasks given to students can be theoretical or practical tasks. Theoretical tasks like as reading assignments particular article, then make a resume for presentation. Practical tasks can bein form of laboratory work, for example is conducting experiment on field work. A worksheet is feasible if it fulfill the criteria of content, readibility, granmar, communicative, presentation, illustration, completeness components that include cognitive (knowledge), psychomotor (skills), affective (attitude). [3]

For developing worksheet within formulating problem, formulating hypotesis, analysis, and concluding, that cause the student learning outcome does not maximum, so the higher order thinking skill is worksheet must be exercisingstudent in learning, in order to maximize the student learning thoroughness and also to give the student provision for formulating problem, formulating hypotesis, analyzing, and concluding the contextual experience from the environment scientifically. For exercizing the higher order thinking skill, teacher has 2 vital role in learning. Therefore, the teachers as an educator is obligated to conditioning the learning activity for student in order to get the ability for developing their thinking skill.

The effort of teacher to conditioning the learning in order to develop the student's thinking skill is designing the appropiate learning model. The success of learning activities needs the specific ability of teacher in every learning model, which according to Bailey, 2008 [4] which describe that every learning model needs an specific ability of teacher and media that used to teach. Alternative that can be used to learn the factors that affecting reaction rate topics is inquiry learning strategy. This learning strategy, student was obligated to find it self the concept that wantedby experiment, so the student can be active and creative in learning process.

In order to get that all,so the experiment worksheet is developed and student can designed it self that experiment steps that was conducted. The concepts that learned by conducting experiment in sub topic the factors that affecting reaction rate is the influence of reactant concentration, temperature, touched survace area, and catalyst in reaction rate. Beside that, in basic competence read that concept can be found by experiment. Student can formulating problem from the existing problem in worksheet. Then from that formulating problem, student can formulate hypotesis and determine the variables that used in conducting experiment (manipulatio variable, control variable, and respin variable). Then student can make the choosingexperiment of equipments and describing materials that will be used. Student conducts experiment with the theirdesign that hasmade and make conclusion from their experiment also. Inquiry orientation worksheet that has developed in inquirylearning strategy with higher order thinking skill was appropriate with the factors that affecting reaction rate.

Problem Formulation

1. How the feasibility worksheet view from teoritical validity from lecturer and teacher based on the contentvalidity, presentation validity, and appropriating with the higher order thinking skill component validity ?

2. How the feasibility worksheet viewed from empirical student based on the contentvalidity, presentation validity, and appropriating with the higher order thinking skill component validity?
3. How is the worksheet feasibility viewed from empirical validity of worksheet based on the test higher order thinking skill of student ?

Purpose

1. Feasibility worksheet view from teoritical validity from lecturer and teacher based on the contentvalidity, presentation validity, and appropriating with the higher order thinking skill component validity.
2. Feasibility worksheet viewed from empirical student based on the contentvalidity, presentation validity, and appropriating with the higher order thinking skill component validity.
3. Feasibility worksheet viewed from empirical validity based on the test higher order thinking skill of student.

METHOD

The type of this research is the development research which is the development experiment worksheet within inquiry on topic of exercise that affecting the reaction rate to exercise the higher order thinking skill of students in 11thgrade. This study based on to the development of the 4-D models (four D models) which proposed by Thiagarajan.

The development model consists of four phases: definition (define), the planning (design), stage of development (develop) and the deployment phase (disseminate) steps [5]. This study is limited in development step only. The subject of this research is experiment worksheet within inquiry on factors that affect the rate of reaction topicto exercise high order thinking skill for senior high school students of 11thgrade. Object of this study is 12 students in11th gradein Bahauddinsenior high schoolSidoarjo who have obtained topic the reaction rate is choosen heterogeneous (4 students have high intelegent, 4 students have medium intelengent, and 4 students haveless intelligent). One group consist of 3 students, which is one high intelegent students, one medium intelegent student, and oneless intelligent students. Amount of all grups are 4 groups.

The instrument that used to collect data in this study are review sheet, validation sheet, higher order thinking skills, student responses sheet, and student activity sheets.

Method of Data Analysis

The data validation result was analyzed by using quantitative descriptive method. Percentage of questionnaire data is obtained based on the calculation of the Likert scale as the Table 1:[5]

Table 1 Likert Scale

Criteria	Score
Very Good	5
Good	4
Good Enough	3
Enough	2
Very Bad	1

The formula used in the calculation to obtain the percentage is:

$$Percentage\ (\%) = \frac{Total\ score\ result}{Score\ criteria}\ x\ 100\%$$

Score criteria obtained through the following calculation:

Score criteria = Highest Score x Total aspects x Total reviewer

The results of the validation sheet analysis is used to determine the feasibility of Student Activity by using the interpretation of the score as follows: [5]

Table 2 Interpretation Score

Precentage(%)	Category
0 - 20	Very Weak
21 - 40	Weak
41 - 60	Enough
61 - 80	Strong
81 - 100	Very Strong

Based on the interpretation criteria, Student Activity Sheet is said as feasible if the content, presentation, conformity with inquiry learning models, and the suitability of higher order thinking skills component if its results was achieving ⩾ 61%, so it can be used in the learning process.

Data on students' responses obtained from the student questionnaire responses after using worksheet. Questionnaire for students, made in "Yes" or "No" answer. Percentage of questionnaire data was analyzed by using Guttman scale which is calculated based on the following table :[5]

Table 3 Guttman Scale

Answer	Score
Yes	1
No	0

Data that obtained are calculated by using the formula:

$$Percentage\ (\%) = \frac{Total\ score\ result}{Score\ criteria}\ x\ 100\%$$

Scorecriteriaobtained throughthe following calculation:

Score criteria = Highest Score x Total aspects x Total reviewer

Percentage that has obtained is interpreting in the criteria that contained in the Table 2.

Criteria interpretation of these scores is said to be fullfil the positive response, if the percentage result of "Yes" answer is ⩾ 61%.So the Student Activity Sheet can be used well.

Data of students' higher-order thinking skills (HOTS)test is gained from the test of HOTS given to students after using the worksheet, then analyzed by calculating the student thoroughness based on an assessment rubric for each component in HOTS and also in overall components of HOTS.

The scores of student's HOTS on each component can be calculated using the formula:

$$Student\ score\ (\%) = \frac{Scores\ of\ each\ component}{Maximum\ score\ of\ each\ component}\ x\ 100\%$$

Then the score of student's HOTS in overall components can be calculated by using the formula:

$$Student\ score\ (\%) = \frac{Scores\ of\ overall\ componen}{Maximum\ score\ of\ overall\ component}\ x\ 100\%$$

Scores on each component and overall was gotten from the test results of HOTS in descriptive formed.

Based on this analysis results, the students was said to be mastery if the HOTS scores for each component and overall was ⩾ 75, it can reinforce the empirical feasibility of worksheet.

Student activity sheets that obtained from the observer is analyzed in descriptive qualitative. Data of student readibility is obtained through the student activity sheet that filled out by observers during conducting the limited trial.

Questionnaire for this observer is made in form of asking students about the readibility of texts, illustration/image, material, and questions in the worksheet. This questionnaire is fullfilled in form of frequency answers.

RESULT AND DISCUSSION

Data that obtained in this development research consist of review result data, validation data, result of higher order thinking skill test data, and readibility of student data. At reviewstep, the reviewers who is lecturers and chemistry teachers which give advice or input for improvement of the design worksheets (worksheet draft I). The reviewers give advice based on the criteria of content, presentation, and conformity with higher order thinking skills component. In general, the contents of criteria need to be equipped with core competencies and providing a summary of the materials which compose key concepts, as well as improvements in reading sentences and questions. Furthermore, from the results of research carried out so that the resulting

revised draft worksheets II. Then worksheet draft II validated by the validator chemistry lecturer and teachers. After worksheet declared worthy of the validation results for precticeexperiment worksheetwithin inquiry oriented to exercise higher order thinking skills that already developed can be tested on a limited trial. Validation results of the worksheet by Table 4:

Table 4 Validation Result of the Worksheet

No	Criteria	Percentage (%)	Category
1.	Contents	87,09	Very Strong
2.	Presentation	91,93	Very Strong
3.	Compliance with inquiry learning model	90,38	Very Strong
4.	Conformity with components of higher order thinking skills	93,06	Very Strong

Validation results worksheet is said to be strong if you get the assessment ⩾ 61% [5]. Based on the criteria of content, presentation, compliance with inquiry learning model, and conformity with components of higher order thinking skills worksheet 1, Worksheet 2, Worksheet 3, and worksheet 4 have strong worksheets for each earn a percentage of ⩾61%.

At worksheet contents and presentation criteria worksheets, which is said to have met the criteria developed by BSNP (2006) developed worksheet already contains material with facts, concepts, and sample means of the concepts presented in accordance with the facts and in accordance with the applicable definitions and examples presented in accordance with reality and efficient to improve the understanding of learners [6] and Instructional Materials Development Guide by Ministry of Education (2008) [7], if they meet the criteria worksheets for all categories.

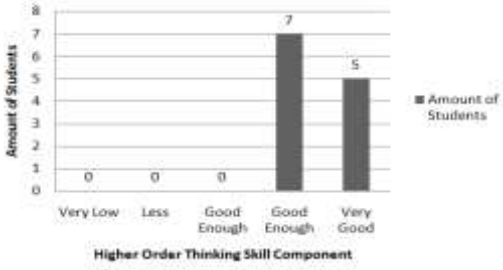
The results of students' response to experiment worksheet with inquiry orientation for higher order thinking skills shown in Table 5:

Table 5 Student Respon Result

No	Criteria	Presentase (%)	Kategori
1.	Contents	99,31	Very Strong
2.	Presentation	89,41	Very Strong
3.	Compliance with inquiry learning model	83,33	Very Strong
4.	Conformity with components of higher order thinking skills	93,75	Very Strong

The results of students' response to experiment worksheet within oriented inquiry for exercise higher order thinking skills practice of criteria based on the content, presentation, compliance with inquiry learning model, and compatibility with higherorder thinking skills component is feasible due to get an assessment of ⩾ 61% [5]. These results are supported by the results of the validation data which provided by the validator in Table 4 which shows that the worksheet is feasible based on the criteria of content, presentation, compliance with inquiry learning model, and compatibility with high order thinking skills component. Thus, it can be concluded that the worksheet is feasible based on the assessment validator (chemistry lecture and chemistry teacher) and students.

The results ofstudent assessmentforhigh orderthinkingskillsare presentedin Picture 1:

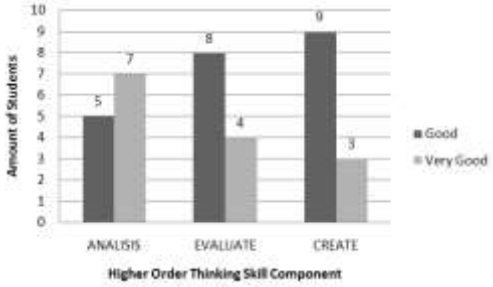


Picture 1 Category Value HigherOrder Thinking Skills Students Overall

Picture 1 can be determined based on the overall category. Seven students were in the very good category and five students were in good category. Overall 100% of students completed because all students scored ⩾ 75. The average score of higher order thinking skills test 11thgrade Bahauddin senior high school Sidoarjo is

83.33%. These averages indicate that the students generally have higher order thinking skills are very good because in the interval 81-100.

The results of students higher order thinking skills were also analyzed based on higher order thinking skills scores for each component. Results of the assessment of each indicator higher order thinking presented in Table 5. Based on the Table, it is known category values higher order thinking skills of students for each component are presented in Picture 2:



Picture 2 Category Value Higher Order Thinking Skills Students Each Component

Picture 2 can be determined based on the category of higher order thinking skills of students in each component. Five students achieved a score analysis between 61-80 (good) and seven students achieved a score 81-100 (very good). Eight students get the evaluation scores between 61-80 (good) and four students achieved a score 81-100 (very good). Nine students achieved a score created between 61-80 (good) and three students achieved a score 81-100 (very good).

Readability of students worksheets indicate that the description or explanation and questions in the worksheets are easy to understand. Overall during limited trial progresses, students are involved in positive activities. This suggests the use of experiment worksheet within inquiry oriented for practice higher order thinking skills can make students more actively in the chemistry learning. Student worksheet overall inquiry oriented on the material factors that influence the reaction rate for higher order thinking skills that practice11thgradesenior high school developed declared eligible by the validator and accompanied by some studets obtained from the test results is limited trial.

CLOSING

Conclusion

Based on the analysis and discussion of research data, it can be concluded that: (1) Feasibility worksheet view from teoritical validity from lecturer and teacher based on the content, presentation, and appropriating validity with the higher order thinking skill component validity, each for 93.20% (very strong), 90.67% (very strong), 86.86% (very strong), and 93.41% (very strong); (2) Feasibility worksheet viewed from empirical student based on the content, presentation, and appropriating validity with the higher order thinking skill component validity respectively by 99.31%(very strong), 89.41% (very strong), 83.33% (very strong), and 93.75% (very strong).(3) Feasibility worksheet viewed from empirical validity based on the test higher order thinking skill of student by 83.33% (very good).

Suggestion

1. Student Activity Sheet is tested multiple times on same material.
2. It is recommended to conduct some exercises again on the same topic. Therefore, it need to develope another learning media that can be used for exercising higher order thinking skills of students.

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