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DEVELOPING WORKSHEET IN REACTION RATE TOPIC TO TRAIN STUDENTS' CRITICAL THINKING SKILL TOWARD GUIDED INQUIRY

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Abstrak

Tujuan dari penelitian ini adalah mengembangkan Lembar Kerja Siswa (LKS) kimia berorientasi inkuiri terbimbing dalam materi laju reaksi untuk melatihkan keterampilan berpikir kritis siswa. LKS disusun berdasarkan indikator berpikir kritis Robert Ennis. Metode penelitian yang digunakan adalah metode *Research & Development* (*R & D*) oleh Sugiyono (2010). Penelitian dilakukan di kelas XI SMA Al-Hikmah Surabaya dengan *pretest-posttest design* untuk mengukur perkembangan berpikir kritis siswa setelah menggunakan LKS laju reaksi. Metode statistik *t-test* pada tingkat signifikansi α = 0.05 digunakan untuk menganalisis. Hasil penelitian menunjukkan bahwa keterampilan berpikir kritis siswa meningkat secara signifikan dimana nilai dari t hitung adalah -0.4852 sedangkan nilai dari t tabel adalah 1.701. Rata-rata hasil kelayakan LKS adalah sebesar 78.6%.
Kata kunci: LKS, inkuiri terbimbing, berpikir kritis, laju reaksi

Abstract

The purpose of this research was developed chemistry worksheet toward guided inquiry in reaction rate topic to train students' critical thinking skill. The worksheet was arranged based on Robert Ennis'critical thinking indicators. Research methodology which was used is Research & Development (R&D) method by Sugiyono (2010). The research was conducted in second grade of Al-Hikmah Surabaya Senior High School by pretest-posttest design to measure the students' critical thinking improvement after used the reaction rate worksheet. T-test statistic methodology at significance level α=0.05 was used to analyze. The results showed that the students' critical thinking skill was increased significantly in which the value of t count was -0.4852, while the value of t table was 1.701. The avarage result of the worksheet feasibility was 78.6%.
***Keywords**: Worksheet, guided inquiry, critical thinking, reaction rate*

INTRODUCTION

Critical thinking is important type of thinking. This form of thinking requires the use of analytical and evaluative cognitive processes and consists mainly of analyzing arguments for logical consistency in order to recognize bias and fallacious reasoning. Critical thinking is type of thinking that particularly important today, because students are exposed continuously to information on television channels, web sites, and social networks that have not been vetted for accuracy. Indeed, many messages found on television and web sites have been created to confuse and deceive. [1]

Ennis explain that critical thinking skill was developed into five indicators: 1) giving basic explanation, 2) developing basic skills, 3) conclusing, 4) arranging further explanation, 5) strategy and tactics. Each indicator consist of some aspect, giving basic explanation consist of formulate a question and formulate a hypothesis, developing basic skill consist of applicate a procedure and report making, conclusing consist of generalization, and concept application, arranging further explanation consist of understanding content and assumption making, strategy and tactic consist of review and give presentation. [2]

Based on that reason, critical thinking is important type of thinking that must be practice in the learning activity, in curriculum 2013 guided inquiry is one example of learning models that can be used. Guided inquiry is another model of instruction that has been developed for the purpose of teaching students how to think. Syntax for inquiry based lessons are: 1) gain attention and explain the inquiry process, 2) present the inquiry problem or discrepant event, 3) have students formulate hypothesis to explain the problem or event, 4)

encourage students to collect data to the test the hypothesis, 5) formulate explanations and/ or conclusions, 6) reflect on the problem situation and the thinking processes used to inquiry into it [1]. Further, Ennis' critical thinking skill indicators was appropriated with guided inquiry characteristic.

Beside that, based on the other research *The Impact of Guided Inquiry Methods of Teaching on The Critical Thinking of High School Students* by Kiumars Azizmalayeri in 2012, inquiry can affect students' critical thinking significanly [3], and research *The Implementation of Inquiry Models in Critical Thinking Skill and Science Concepts Understanding of Junior High School* by Anggareni in 2013, the inquiry model actually can improve the students' critical thinking [4]. Many research showed that inquiry model can increase the students' critical thinking. Now, how to applicate guided inquiry as the learning model in the class to train students' critical thinking skill is a great task for education.

Depdiknas explain that worksheet is papers are arranged as students' orientation to implement programme study in their learning activity. Worksheet consists of outline, question, and information for students to open wide their knowledges and to understand their learning materials [5]. Sadiq also explain that worksheet consist of information and task, it's arranged to guide students in programme work or learning materials that only a few or without teacher guiding [5]. Therefore, worksheet can be a rule for students to do their learning activity, with worksheet they can implement inquiry model to train students' critical thinking skill with a few or without teacher guiding. Worksheet will help student and teacher to do their learning activity and to well understanding their learning materials.

Therefore the existence of worksheet in the learning activity is important today. Worksheet give considerable influence in the learning process so that the preparation of worksheets must fulfill various requirements that are didactic requirements, construction requirements, and technical requirements. Didactic requirements: regulates the use of worksheets that are universal can be used by student is slow or that clever. Terms of construction: related to the use of language, sentence structure, vocabulary, level of difficulty, and clarity of the worksheet. Technical requirements: emphasizes presentation of worksheet, in the form of text, image, and appearance in the worksheet. [6]

Based on that reasons. The purpose of this research was developed chemistry worksheet toward guided inquiry. The worksheet use to train students' critical thinking skill, so the students can face confuse and deceive information in the daily life. The research was done by the following research question:

1. How are the feasibility of the worksheet in reaction rate topic toward guided inquiry orientation to train students' critical thinking?
2. Is there a significant critical thinking different between before and after students used the worksheet in reaction rate topic toward guided inquiry orientation that have been developed?

METHOD

The research methodology that used was *Research & Development* (*R&D*) method that was explained by Sugiyono. *Research & Development* (*R&D*) by Sugiyono (2010) have ten processes: 1) potential and problem, 2) collect data, 3) product design, 4) design validation, 5) design revision, 6) product test, 7) product revision, 8) implementation test, 9) product revision, and 10) massal production [7]. Based on Sukmadinata that was modified that process into three processes: 1) first study, 2) product development, and 3) product test [8], so, the realization of this research was definited until product test.

This research was conducted in second grade of Al-Hikmah Surabaya Senior High School by *pretest-postest design*. *Pretest-postest design* was research design that gave student test before and after use the product (worksheet) that have been developed. Those test were used to know the student's critical thinking skill differences in the learning activity by using the worksheet. The design can be formulated as:

O1	X	O2

Explanation
O1 = test before treatment
X = treatment by using the worksheet
O2 = test after treatment [7]

Data Resources

This research uses data sources from: research sheet, validation sheet, and student test sheet. research sheet filled out by an expert. Validation sheet filled out by two chemistry lectures and two chemistry teachers. Student test sheet given to students before and

after using the worksheet, the students test sheet is used to determine the significant different student's critical thinking skills.

Treatment and Instruments

Research Sheet

Research of worksheet conducted to provide advice based on the strengths and weaknesses were found in terms of content, presentation, language, compliance with the guided inquiry models, and compliance with the critical thinking indicators. Furthermore, based on the results of the research, researchers revised the product I to produce products II. The product II that finish then ready to be validated.

Validation Sheet

Validation sheet filled by experts, two chemistry lectures from Surabaya State University and two chemistry teachers from Al-Hikmah Surabaya Senior High School. Validation was conducted to know the feasibility of worksheets based on defined aspects.

Student Test Sheet

Student test sheet given to students before and after using the worksheet. This tests consist of question to measure the students' critical thinking by using Ennis' critical thingking indicators. The kind of question that used in student test sheet was essay question in which essay question is kind of question that use to measure the students' cognitive level more than recall information. [9]

Analysis of data

Analysis Research

Analyzed qualitatively by criticism and suggestions of experts who provide it. The worksheet research result is a material improvement of the worksheet.

Analysis Validation

Data validation results were analyzed using quantitative descriptive models. This analysis is used for each of the criteria that set out in the validation sheet. Percentage of data obtained using a Likert rating scale calculation:

Table 1 Likert Rating Scale

Valuation	Rating Scale
Very bad	1
Bad	2
Enough	3
Good	4
Very well	5

[10]

For the calculation of the categories percentage used the following formula:

$$P(\%) = \frac{score\ of\ total\ data\ collection}{criteria\ score} X\ 100\%$$

Explanantion

Criteria score = the highest score *x* number of questions in the questionnaire *x* number of respondents

Percentage obtained interpreted into criteria that can be seen in the table below:

Table 2 Criteria Score

Percentage	Criteria
0.01 – 20.99	so do not feasible
21.00 – 40.99	do not feasible
41.00 – 60.99	less feasible
61.00 – 80.99	feasible
81.00 – 100.00	very feasible

[10]

Validation of learning tools of this research includes the suitability of the feasibility learning of the content, presentation, language, compliance with the guided inquiry model, and compliance with critical thinking indicators. Based on the criteria according to the Likert scale by Riduwan, the learning tool is feasible if the percentage of the value obtained from the results of the validation is ≥ 61%. So it can be worthy for use in teaching and learning. [10]

Analysis Test Sheet

This analysis to determine students' critical thinking. Students completed individually when reaching a minimum average score of 2.66 on 1-4 range with minimal predicate is B- [11]. In addition, to determine and prove the significance level critical thinking skills of students before and after using the worksheets. Data differences between pretest and posttest results statistically tested by *t-test* correlated. The formula used is

$$t = \frac{x_1 - x_2}{\sqrt{\frac{s_1^2}{n_1} + \frac{s_1^2}{n_2} - 2r\left(\frac{s_1}{n_1}\right)\left(\frac{s_2}{n_2}\right)}}$$

Note

$x_1 = pretest\ average$

$x_2 = postest\ average$

$s_1 = pretest\ standard\ deviation$

$s_2 = postest\ standard\ deviation$

$s_1^2 = pretest\ variants$

$s_2^2 = postest\ variants$

$r = Correlation\ between\ the\ both\ group$

The formula of standard deviation and variants based on Sugiyono as follow:

$$s = \sqrt{\frac{\sum(x_i - x)^2}{(n-1)}}$$
$$s^2 = \frac{\sum(x_i - x)^2}{(n-1)}$$

The formula used to test the research statement

Ho = There is no difference between the students' critical thinking skills before and after using the worksheet.

Ha = There are differences between the students' critical thinking skills before and after using the worksheet.

$$H_o: \mu_1 \leq \mu_2$$
$$H_a: \mu_1 > \mu_2$$

Based on the calculations and statements above, it can be conclude that the use of worksheets have significant differences when Ha is received, where $\mu_1 > \mu_2$. [12]

RESULT

Product Development

Field Study

A field study was conducted to determine the potential and current problems. Currently, it is known that the potential in most high school allows to carry out the nice and comfortable learning activities, especially at Al-Hikmah Surabaya Senior High School as a research site. The problem now is how to achieve learning objectives, if the worksheets that correspond to the prevailing curriculum goals are still rare.

Analysis Curriculum

The curriculum used today in Indonesia is the Curriculum 2013 with scientific approach, in which the learning process requires students to observe the activity, ask, gather information, reason/ associates, and communicate the results. This scientific approach is also considered very fit with syntax inquiry based learning based on Arends. So the inquiry model as the basis for the preparation of worksheet is a choice that feels right.

Analisys of Students's Condition

Analysis of the condition of the students performed to determine the condition of students in participating in learning activities. Based on interviews with chemistry teacher, it is known that students in a class divided by the level of cognition and different characters. Students have had a study in group with 4-5 members. In other side, based on the questionnaire, it is known that in the chemistry subjects, 60% second grade students in senior high school experiencing difficulty in reaction rate topic. Therefore, reaction rate will be choosen as a topic in the worksheet that develop.

Concept Analysis

The concept that can be used based on students difficulties and student learning activities is the concept of factors that affecting reaction rate.

Design Worksheet

Format of the reaction rate worksheet is based on preparation worksheet book. Worksheet will be arrange with the following stuctures: cover, introduction, table of contents, outline, information, learning activities, and questions [13]. In addition to these structures, which is no less important is the worksheet will be develop based on compliance with Arend inquiry model, and based on compliance with critical thinking indicators by Ennis.

Worksheet Research

Based on worksheets research, the reaction rate worksheet that have been developed must be repaired in some aspects: ilustration presentation or images, general appearance variation, and the grammar.

Worksheet Revision

Repair and revision are arranged by advice on the research sheet.

Worksheet Validation

Worksheet assessment by validator include aspects of the feasibility of the content, presentation, language, compliance with the inquiry base learning and compliance with critical thinking indicators. Validation is done by two chemistry teachers and two chemistry lecturers. The average results of the validation are presented in the following table.

Table 3 Analysis of worksheet validation

Criteria	Percentage (%)	Criteria
Contents	81	very feasible
Presentation	81	very feasible
Lenguage	80	feasible
Compliance with guided inquiry models	79	feasible
Compliance with critical thinking indicators	72	feasible

Based on **table 3** data is known that worksheet in reaction rate topic toward guided inquiry that developed based on the scores criteria [10] is very feasible in the aspect of content and presentation with a percentage of 81%, feasible in the aspect of language with a percentage of 80%, feasible in the aspect of compliance with guided inquiry models with a percentage of 79%, and feasible in the aspect of compliance with critical thinking indicators with percentage 72%. So based on the results of the validation, worksheets in reaction rate topic toward guided inquiry to train critical thinking skill that have been developed feasible for use in learning activities.

Student Test Sheet Result

Before tested statistically by *t-test* correlate the results of pretest and posttest need normality test to determine that the data obtained normal distribution. A data form a normal distribution when the number of data above and below the median are the same, as well as standard deviation. If the data to be analyzed is normally distributed then the *t-test* statistical techniques can then be used. According Sugiyono [12], the data normality testing technique is by using Chi Square (X^2) with equation:

$$x^2 = \sum_{i=1}^{k} \frac{(f_0 - f_h)^2}{f_h}$$

Explanation

Fo = the frequency or amount of data on the observation

Fh = the amount or frequency of the expected

Fo-Fh = Data difference between Fo-Fh

If the value of the Chi Square count is less than the value of the Chi Square tables, the data revealed a normal distribution.

Based on the calculation results obtained Chi Square count in pretest was 5, Chi Square table was 11.070. Because the value of Chi Square count is less than the value of Chi squared table, then the data distribution in pretest expressed normal distribution. While the results of the calculation obtained Chi Square count in posttes was 2.2 and the value of Chi Square table was 11.070. Because the value of Chi Square count in posttest is less than the value of the Chi Square table, then the data distribution in posttest expressed normal distribution.

The data distribution in pretest and posttest was normal distribution then the *t-test* statistical techniques can be used. Where, if the value of t count is less than the value of the t table then the result is declared to have significant differences. Based on calculations, obtained t count was -0.4852, while the value of t table was 1.701. Because the value of t count is less than t table, it can be concluded that there are significant differences in critical thinking skills of students before and after use the worksheets. After using the worksheets in reaction rate topic toward guided inquiry that developed critical thinking skills of students in the sample increased.

CLOSING

Conclusion

Based on the result we can conclude that:

1. Worksheet in reaction rate toward guided inquiry orientation to train the student's critical thinking skills appropriate to use with feasibility criteria in content was 81%, the presentation was 81%, language was 80%, compliance with the guided inquri models was 79%, and compliance with critical thinking indicators was 72%.
2. The students' critical thinking increased significantly after using the worksheets were developed.

Suggestion

1. Product still require further development in order to produce a better product that able to deliver innovation in teaching chemistry.
2. Product has a good value but needs to be tested on a broader level to high school students to corroborate evidence worksheet quality.
3. Critical thinking skills is a very important skill to face global era so that the product development to train critical thinking skills are still needed.

BIBLIOGRAPHY

1. Arends, Ricard. I.. 2012. *Learning to Teach*. Ninth Edition. New York: Mc Graw-Hill.

2. A.L Costa. 1985. *Developing Mind: A Resource Book for Teaching Thinking*. Virginia USA: ASCD.

3. Kiumars Azizmalayeri, Ebrahim MirshahJafa, Mostafa Sharif, Mohammad Asgari, and Maboud Omidi. 2012. "The Impact of Guided Inquiry Methods of Teaching on The Critical Thinking of High School Students". *Journal of Education and Practice*. Vol. 3, No 10.

4. Anggareni, Ristiati, Widiyanti. 2013. "Implementasi Strategi Pembelajaran Inkuiri terhadap Kemampuan Berpikir Kritis dan Pemahaman Konsep IPA Siswa SMP". e-*Journal Program Pascasarjana Universitas Pendidikan Ganesha*. Vol. 3, 2013.

5. Widiyanto, Ahlis, M.J. Ni'am, dan E.Y. Nurcandra. 2008. "*Lembar Kerja Siswa (LKS) Matematika Interaktif Model E-Learning*". (online). (http://ahliswiwite.files.wordpress.com, download at Juni 4th 2014).

6. Hendro Darmodjo & Jenny R.E Kaligis. 1992. Pendidikan IPA. Proyek Pembinaan Tenaga Kependidikan Direktorat Jenderal Pendidikan Tinggi Departemen Pendidikan dan Kebudayaan

7. Sugiyono. 2010. *Model Penelitian Kuantitatif Kualitatif dan R&D*. Bandung: Alfabeta.
8. Sukmadinata, Nana Syaodih. 2010. *Metode Penelitian Pendidikan*. Bandung: PT. Remaja Rosdakarya.
9. Suke, Silverius. 1999. *Evaluasi Hasil Belajar dan Umpan Balik*. Indonesia, Jakarta: Gramedia Widiasarana.

10. Riduwan. 2012. *Skala Pengukuran Variabel - Variabel Penelitian*. Bandung: Alfabeta.

11. Permendikbud Nomor 59 Tahun 2014. (Online) (http://hukor.kemdikbud.go.id/asbodoku/media/peruu/permen_tahun2014_nomor059.zip, download at Oktober 23th 2014).

12. Sugiyono. 2010. *Statistika untuk Penelitian*. Bandung: Alfabeta.

13. Anonim. *Pedoman Penyusunan LKS*. (Online) (http://118.96.137.51:888/bahanajar/download/adm_pendidikan/PEDOMAN%20PENYUSUNAN_LKS.pdf, download at Mey 13th 2014).