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THE DEVELOPMENT OF STUDENT WORKSHEET WITH MIND MAPPING STRATEGY FOR IMPROVING LEARNING OUTCOMES IN THERMOCHEMISTRY TOPIC

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Abstract

The aims of this study are to know the feasibility of student worksheet with mind mapping strategy that had been developed as a learning media on thermochemistry topic. The research method that used was research and development (R&D) method that consist of 10 steps. But this research was conducted until 6th step only, namely product testing. This worksheet had been reviewed and validated by 2 chemistry lecturers and a teacher. Then it had been tested on 15 students in the 11th grade of Bahauddin Senior High School Sidoarjo. The result of this research showed that student worksheet with mind mapping strategy on thermochemistry topic that had been developed was feasible to be used as learning media. This was shown based on the assessment result from chemistry lecturers and teacher, viewed from teoretical validity including content validity which was suitability of matter aspect, and construct validity which are presentation, linguistic, and suitability with the rules of mind mapping aspects, which had percentage of 86,67%, 85,33%, 80% and 92,22%. While empirical validity was based on student responses. It has very feasible result with percentage of 94,67% and also student learning outcomes were increase after limited trial through t-test analysis. So it could be concluded that the student worksheet with mind mapping strategy was very feasible as learning media on thermochemistry topic.

Key words: student worksheet with mind mapping strategy, thermochemistry

Abstrak

Tujuan dari penelitian ini adalah untuk mengetahui kelayakan LKS berstrategi mind mapping yang dikembangkan sebagai media pembelajaran pada materi pokok termokimia. Metode penelitian yang digunakan adalah Research and Development (R&D) yang terdiri dari 10 langkah. Namun pada penelitian ini hanya terbatas sampai enam langkah saja yaitu uji coba produk. Media 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 15 orang siswa kelas XI SMA Bahauddin Sidoarjo. Hasil penelitian menunjukkan bahwa LKS berstrategi mind mapping pada materi termokimia yang dikembangkan telah layak digunakan sebagai media pembelajaran. Hal ini ditunjukkan dari persentase hasil penilaian dari dosen kimia dan guru kimia, yang ditinjau dari validitas teoritis dalam segi isi yakni aspek kesesuaian materi dengan kurikulum yang digunakan, dan dalam segi konstruksi yakni aspek penyajian, kebahasaan, dan penilaian kesesuaian LKS dengan aturan mind mapping yang memperoleh persentase berturut-turut sebesar 86,67%, 85,33%, 80% dan 92,22%. Sedangkan validitas empiris yaitu berdasarkan respon siswa, mendapat hasil sangat layak dengan persentase sebesar 94,67% dan hasil belajar siswa mengalami peningkatan setelah uji coba terbatas melalui analisis statistik uji t dengan hasil yang positif. Maka dari itu, dapat disimpulkan bahwa LKS berstrategi mind mapping dinyatakan sangat layak digunakan sebagai media pembelajaran pada materi pokok termokimia.

Kata Kunci : *LKS berstrategi mind mapping, termokimia*

INTRODUCTION

The growed human civilization had now entered the globalization era. The globalization era was an era of quality competition, who had the quality, he would be improve and able to maintain its existence. Therefore, the development of qualified human resource was something that can not be negotiable. [1]

The development of qualified human resources could not be separated from the role of education that existed in the country. One way to improve the quality of human resources was from the educational process. Educational process was functioned as a tool to achieve educational goals. This was as a competency that must be achieved in the educational endeavor. However good and ideally a competence formulation, finally its success was really depends on the implementation of the learning process that was done by the teacher. [2]

Based on the National Education Standards which was mentioned about the learning process that should be implemented in schools read that "the learning process on the education unit must implement an interactive, inspiring, fun, challenging, and motivating students to actively participate, and provide an enough space for the initiative, creativity and independence which approppriate with the talents, interests, physical development and psychological of students ". [3] In general, it could be concluded that the learning process should not be monotonous, the teacher must be able to manage the learning process in classroom. One of the ability to manage the learning process that must have by the teacher was to select and implement the learning strategies that appropriate with the students character.

In the learning process of Curriculum 2013 had emphasized that the teacher was no longer as a major role because students could learn without having to wait an explanation from the teacher but they could take advantage from the available learning resources. One of the learning resources that could be used was the Student Worksheet. [1]

Student Worksheet was a sheet containing the task that done by the student. The worksheet contained instructions and the steps to complete a task. The task could be either theory or practice. [4]

Some of the benefits and objectives of the worksheet were (a) to enable students in the learning process, (b) to assist students in developing concepts and ideas, (c) to train students to discover and develop the teaching and learning process, (d) as the guidelines for teachers and students in implementing the learning process, (e) to help students obtaining a record of the material learned through learning activities, (f) to help students to understand the information of the concepts learned through the learning activities systematically. [5] Thus, by that explanation of the worksheet availability, it was expected that students could be more active in the learning process without totally depend on the teacher and could also help students to more easily understand the learning concept and got the independent learning experiences.

Based on the interviews in chemistry teacher of Bahauddin Senior High School Sidoarjo, the learning process that usually done in the classroom was the teacher presented the material and followed by the students wrote the board' notes as well as the information that said by the teacher. Most of the student record book contained the answers of the exercises given by the teacher. This was appropriate with the results of a questionnaire that was distributed to 30 students who showed that 76.67% of students always noted the information in the board in their notebooks, but 70% of students did not understand the contents of their records. This indicated that when noted, students just wrote without any understanding of the information obtained because that recording was less effective.

The results of the questionnaire also showed that 76.67% of students were difficult to study chemistry, especially in the thermochemistry topic (63.33%). In addition, based on the interview results, the teacher stated that most of the students grade XI had low scores on thermochemistry topic. It was also appropriate with the percentage results data of chemistry national exam 2010 in East Java which showed that the students' mastery in thermochemistry topic was only 42.63%. [6] This suggested that the students' understanding in thermochemistry topic was generally still low, so it needed a solution to overcome this.

Noting was the one important ability for everyone especially for the students, because it could improve memory. Quantum learning author stated that:

"Without notes and repeat, most of people only remember a small portion of material that they read or hear. Effective record can save time by helping you save information easily and remember it again if necessary. " [7]

The facts showed that the recording technique during this time was less effective, so it needed an effective recording technique in the learning process. Therefore, researcher would like to introduce an effective record technique Mind Mapping. Mind mapping was a method of creative and effective record that could be used to assist the process of learning, organizing, problem solving, making the decision until planning a job. [8] Mind mapping or mind map was a method to learn a concept invented by Tony Buzan. This concept was based on the workings of the brain to store the information. The results showed that our brain did not store information in the boxes lined up neatly nerve cells but rather collected in nerve cells which were branching, if at a glance it would seem like the branches of a tree. From these facts, it could be concluded that we also store information like the workings of the brain, the better information stored in the brain, of course our learning process would be easier. [9]

Mind mapping always used colors, lines, symbols, words and images. Natural structure of a mind mapping was radial which radiating out from a central image. By using mind mapping, the long list and tedious information could be transformed into colorful diagrams, it was easy to remember and very irregular, and in line with the natural workings of the brain. It was very easy for the brain to understand and absorb the information. [8]

The workings of the mind mapping was to write the main theme as a central point and think the branches or derivative themes that came out from the middle point and found the relationship between that derivative theme. It means that the focus was directed at what the main theme, the important points of the main themes that being studied, the development of each critical points and found the relationship between each point. With the availability of this mind mapping, it could be obtained whatever things that already known and which areas which did still not understood well. The making of mind mapping could be used as a fun activity for students. Because it used images and colors in the making. [2]

Based on these descriptions, researcher was interested in Developing The Student Worksheet with Mind Mapping Strategy for Increasing the Learning Outcomes of Students grade XI in Thermochemistry Topic.

METHOD

Research was conducted in Bahauddin Senior High School Sidoarjo. This research included into development research. The method used was Research and Development (R&D).

There were 10 steps in R&D method, namely the potential and problems, data collection, product design, design validation, design revisions,

product testing, product revision, trial usage, product revision, and mass production. [10] But, because of this research was only confined for feasibility trial, so the step for R&D method was limited until the sixth step only namely product testing. The object of this development research was Mind Mapping Strategy Worksheet. While the subject of this development research was 15 students of Bahauddin Senior High School Sidoarjo that heterogenous and also had gotten thermochemistry topic before.

The collecting data methods in this research were test method (pretest-posttest), survey method (review, validation, students' responses) and observation method.

Methods of Data Analysis

The data obtained was analyzed by using qualitative and quantitative analyzed method. Qualitative analyzed method was used for analyzing the data of reviews result and tstudent activities observation result. While quantitative analyzed method was used for analyzing the data of validation result, student responses result and pretest-posttest result.

The percentage of validation result was gotten based on the Likert scale in the table 1 below: [11]

Table 1 Likert Scale Score

Criteria	Score
Very Good	5
Good	4
Good Enough	3
Very Bad	2
Nothing	1

with the formula for obtaining the validation percentage was:

$$P\ (\%) = \frac{F}{N\ x\ I\ x\ R}\ x\ 100\ \%$$

Keterangan: P = percentage of feasibility, F = amount of overall respondent' answers, N = highest score in questionnaire, I = number of questions, R = number of respondents.

That percentage results then used to know the feasibility of mind mapping worksheet through the score interpretation below: [11]

Table 2 Interpretation Score of Validation

Percentage	Criteria
0% - 20%	Very Less
21% - 40%	Less
41% - 60%	Good Enough
61% - 80%	Good
81% - 100%	Very Good

The student worksheet with mind mapping strategy was feasible if the validation percentage was ≥61%.

While the student responses result was obtaining based on the Guttman scale in table 3 below: [11]

Table 3 Guttman Scale Score

Answer	Score
Yes	1
No	0

The percentage of student responses result was calculated by using this formula:

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

description: P = percentage of respondent answer; F = amount of respondent answers; N = number of respondent.

The percentage of students' responses then used to know the feasibility of mind mapping strategy worksheet through the interpretation score in table 2.

If the data of pretest-posttest was normally distributed, so for testing the hypothesis was used t-test method with the formula:

$$t = \frac{x1 - x2}{s\sqrt{\frac{1}{n1} + \frac{1}{n2}}}$$

[12]

with t = student distribution; x1 = mean of posttest result; x2 = mean of pretest result; n1 = number of student in posttest; n2 = number of student in pretest; s = varians. The hyphotesis test criteria was accepting Ho if $t_{calculation} < t_{table}$, and vice versa, rejecting Ho if $t_{calculation} > t_{table}$.

Beside using t-test method, researcher also used linier correlation to know the relation between the student

cognitive ability and creating mind mapping ability. The formula was:

$$r = \frac{N\,\Sigma XY - (\Sigma X)(\Sigma Y)}{\sqrt{(N\,\Sigma\,X^2 - (\Sigma X)^2\,(N\Sigma Y^2 - (\Sigma Y)^2}} \quad [12]$$

with N = number of students; x = mind mapping ability; y = cognitive ability.

RESULT AND DISCUSSION

The data of this development research included qualitative data which was reviews data and students activity' observation data, and quantitative data which was validations data, students' responses data, pretest-posttest data and creating mind mapping data. Based on the research procedure, before taking the data in limited trial, the worksheet with mind mapping strategy (worksheet draf 1) had to review and revise before to yield worksheet draf 2 and then it was conducting validation from chemistry lecturers and teacher.

After the worksheet with mind mapping strategy was declared as feasible based on the validation result, so the worksheet with mind mapping strategy that had been developed may implemented in limited trial. The validation result of the worksheet with mind mapping strategy was presented in table 4:

Table 4 Validation Result of the Worksheet with Mind Mapping Strategy

Aspects that Assessed	Percentage (%)	Criteria
A. Content Aspect		
1. Worksheet Component		
a) Basic competence was operationally written.	100	Very Feasible
b) Learning outcome' indicator was written clearly.	80	Feasible
c) Matter description was already containing the important concepts.	80	Feasible
d) Questions in worksheet were easy to understand.	93,33	Very Feasible
e) Questions in worksheet were appropriate with learning outcome' indicator.	80	Feasible
2. Worksheet Matter		
a) Worksheet matter was appropriate with the Curriculum 2013.	93,33	Very Feasible
b) Worksheet matter was relevant with the Indicator.	93,33	Very Feasible
c) Worksheet matter was already containing the truth of concepts.	80	Feasible
d) Worksheet matter was systematic.	80	Feasible
Average	86,66	Very Feasible
B. Presentation Aspect		
1. Worksheet Presentation		
a) Worksheet presentation was logic and systematic.	93,33	Very Feasible
b) Worksheet presentation was appropriate with the student' level thinking and ability of reading.	93,33	Very Feasible
c) Worksheet presentation pushed the student active in learning activity.	80	Feasible
d) Worksheet presentation viewed the variation of student' learning styles.	80	Feasible
2. Worksheet Physical	93,33	Very Feasible
a) Size of alphabet in worksheet was easy to read.	80	Feasible
b) Picture in worksheet helped the concepts' understanding.	93,33	Very Feasible
c) References writing were appropriate with the rules.	80	Feasible
d) Cover represented the worksheet contents.		
3. Worksheet Illustration	80	Feasible
a) Worksheet illustration and picture was relevant with the matter or topic.	80	Feasible
b) Worksheet illustration and picture could present the concepts clearly.		
Average	85,33	Very Feasible
C. Linguistic Aspect		
1. Worksheet Linguistic		
a) Worksheet writing used the good and true Indonesian.	80	Feasible
b) Worksheet writing used the appropriate language with the students' age and	80	Feasible

Aspects that Assessed	Percentage (%)	Criteria
thinking level.		
c) Worksheet writing used the easy understanding and exactly vocabularies.	80	Feasible
d) The language among chapter, sub-chapter, paragraph and sentences was continually systematic.	80	Feasible
e) Worksheet writing used the consistent symbols and vocabularies.	80	Feasible
Average	80	Feasible
D. Mind Mapping Aspect		
1. Suitability between worksheet and Mind Mapping Rules.		
a) Main idea was in the center.	100	Very Feasible
b) The color was different in each first branch.	93,33	Very Feasible
c) The picture, symbol, code, and dimension were varieties.	93,33	Very Feasible
d) The branch was thinner as far from the center as possible.	93,33	Very Feasible
e) The keyword was written on the branch.	80	Feasible
f) The tidiness of mind map was appropriate with the paper size.	93,33	Very Feasible
Average	90,66	Very Feasible
Overall Validation Result	86,06	Very Feasible

In the pretest result data was conducted normality test to know that the obtained data was normally distributed. In the pretest-posttest result data would be tested by using t-test method to know the difference of students learning outcomes after using the worksheet with mind mapping strategy in limited trial. While in the posttest result and creating mind mapping result would be analyzed by using regretion analysis and linier correlation to know the influence between students' posttest result and the creation of mind mapping.

The students' pretest results showed that the data retrieved was normally distributed, so then it performed t test. The hypothesis was Ho: μ Ssp= μ Sbp = (there was no difference between the results of the pretest to the posttest results) and H_1: μ Ssp> μ Sbp = (there was a difference between the results of the pretest to the posttest results, or the posttest results was greater than the pretest results) The analysis results above showed that the value of $t_{count} > t_{table}$ so that Ho was rejected and H_1 was accepted. This analysis showed that the cognitive abilities of students after using the worksheet on limited trial were better than before using the worksheet. Based on this hypothesis, it was concluded that the worksheet with mind mapping strategy in thermochemistry topic that had been developed could improve the learning outcomes of students grade XI.

To find out how strong the relationship between the ability of making mind mapping with the cognitive ability of the student, it used correlation analysis and to predict one variable when the other variables known, it used linear regression analysis.

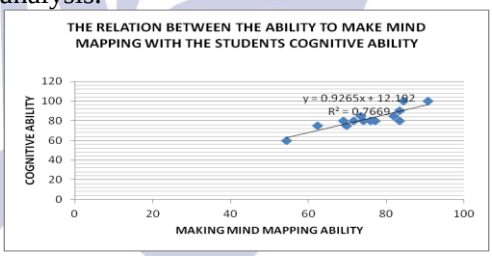

Figure 1 Graph of relationship between the ability to make mind mapping with the students' cognitive ability

By doing calculation, it obtained a value = 12.192 and b value = 0.9265. So the regression equation between the ability to make mind mapping and the students cognitive abilities were:

$Y = a + bX$

$Y=12.192+0.9265X$

coefficient a was constant value of Y when the value of X = 0 and b was called the coefficient of linear regression direction and suggested the changes in the variable X by one unit. This change represented an increase in value when b is positive. From the calculation, the value of

b = 0.384 was positive, so it could be stated that for any average of students' making mind mapping capability was increased with a level of ability, the average of students cognitive abilitiy was also increased by 0.9265. In addition, based on the calculation of correlation coefficients, it obtained a positive correlation of r = 0.875. While the coefficient of determination r^2 = 0.8752 = 0.766. This suggested that the cognitive abilities of students were 76.6% could be explained by the ability of students to make mind mapping in the limited trial. The remaining 23.4% was determined by the other factors.

To evaluate the response of 15 students to the worksheet with mind mapping strategy that tested, students were asked to complete a questionnaire. Overall analysis of the students responses to the the worksheet with mind mapping strategy could be seen in the following graph:

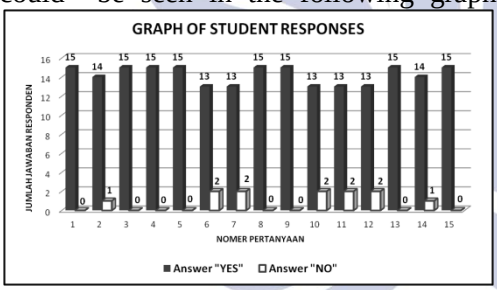

Figure 2 Graph of Students Responses

Questions that asked on the student response' questionnaire was about the presentation of the worksheet, language of worksheet, content or material of worksheet, mind mapping, and student interest in mind mapping worksheet that had been developed.

Based on the figure 3, it can be seen the comparison of students responses with yes and no answers. The number of students who responded with a yes answer indicates that the students were positively responded to the worksheet with mind mapping strategy that tested. The analysis results of the student responses was also supported by the observation results, so that it could be seen the correspondence between the results achieved with the running processes. The observation data obtained from the observation of student activity when using the worksheet with mind mapping strategy and then it was written on the observation sheet by the observer. The number of observer was three people, while each observer observes five students when using the worksheets.

A high percentage of student responses were obtained in a statement that the text and images on a worksheet easier to read and understand which was the percentage of 100% qualifies as very strong. In addition, the design and presentation of worksheet was also interesting with the percentage of 93.33% (very strong). This includes the design that was tailored to the worksheet aesthetic value in assessment aspects. One of them was to attract the worksheet users in this case were students. [13] This response was supported by the observation that 100% of students could read the text and images on worksheets clearly and easily and 100% of students were smoothly when using the worksheet with mind mapping strategy.

Linguistic, instructions and questions in the worksheets were also easy to understand by the students with a percentage of 86.67% qualifies as very strong. This was supported by the observation that 93.33% of students can read the material in the worksheet easily and 73.33% of students did not ask about the clues and questions in the worksheets. By using the worksheet with mind mapping strategy, the activity of note taking that usually did became more fun, it indicated by the percentage of 100% qualifies as very strong. This was supported by the observation results that 80% of students did not complain when using the worksheets.

CLOSING

Conclusion

Based on the analysis and discussion of research data, it can be concluded that: (1) mind mapping strategy

worksheet that had been developed was very feasible to be used as learning media in terms of the theoretical validity from chemistry lecturer and teacher with a percentage of 86.05%; (2) mind mapping strategy worksheet was also very feasible to be used as learning media in terms of empirical validity based on the students' responses which are supported by student activity with a percentage of 94.67%; (3) mind mapping strategy worksheet could increase the learning outcomes of students in limited trials, with the capability of making mind mapping 76.6% was powerful related to the students' cognitive abilities.

Suggestion

1. In this research was conducted until limited trial step only, therefore it needed the next research so that the worksheet with mind mapping strategy can be used more widely.
2. In independent learning, the worksheet with mind mapping strategy was emphasized in cognitive ability, so in the learning implementation, it can be used the relevant learning model for exersizing the affective and psychomotor abilities.

REFERENCES

1. Mulyasa, E. 2013. *Kurikulum 2013.* Bandung: PT. Remaja Rosdakarya.

2. Tsaney, Khurri dan Kamaluddin. 2014. *Pengaruh Penerapan Mind Mapping terhadap Hasil Belajar Siswa pada Materi Listrik Dinamis di Kelas X SMA Negeri 3 Lamongan.* ISBN 978-602-14702-6-8.

3. *Standar Nasional Pendidikan (Peraturan Pemerintah Republik Indonesia No. 19 Tahun 2005 tentang Standar Nasional Pendidikan).* Jakarta: Sinar Grafika.

   Departemen Pendidikan Nasional. 2009. *Pedoman Umum Penyusunan Lembar Kerja Siswa dan Skenario Pembelajaran SMA.* Jakarta: Direktorat Jendral Manajemen Pendidikan Dasar dan Menengah. Direktorat Pembinaan SMA.

4. Acmadi, Harun Rasid. 1996. *Telaah Kurikulum Fisika SMU (Model Pembelajaran Konsep dengan LKS) Departemen Pendidikan dan Kebudayaan*. IKIP Surabaya: University Press IKIP.

5. _____. 2010. *Sistem Informasi Hasil Ujian Nasional.* Jakarta: Depdiknas

6. De Porter, Bobbi dan Mike Hernacki. 2007. *Quantum Learning: Membiasakan Belajar Nyaman dan Menyenangkan.* Bandung: KAIFA.

7. Buzan, Tony. 2005. *Mind Map untuk Meningkatkan Kreatifitas.* Jakarta: PT. Gramedia Pustaka Utama.

8. Suyatno, 2008. *Pembelajaran dengan Peta Pikiran.* Tersedia pada laman web http://garduguru.blogspot.com [accesssed on 10 October 2013]

9. Sugiyono. 2010. *Metode penelitian Kuantitatif, Kualitatif dan R&D*. Bandung: CV Alfabeta.

10. Riduwan. 2005. *Skala Pengukuran Variabel-Variabel Penelitian*. Bandung: Alfa Beta.

11. Sudjana, 2005. *Metoda Statistika*. Bandung: Parsito.

12. Munadi. 2009. *Media Pembelajaran : Sebuah Pendekatan Baru*. Ed. Agus Hikmat Syaraf. Jakarta: Gaung Persada Press