

# Development of Guided Inquiry and Mind Mapping-Based Worksheet to Improve Students' Creative Thinking Skills

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## ABSTRACT

The aim of this research was to develop a proper student activity sheet to improve students' creative thinking skill on the stoichiometric material. The properness of worksheet was assessed based on validity, practicality, and effectiveness. The development of worksheet used Research and Development (R&D) method and was implemented to 2nd grade Senior High School with one group pre-test – post-test design. The research instruments include observation, test, and questionnaire sheets. Data were analysed quantitatively descriptively. The results showed that: (1) worksheet is very valid and could be used as a learning media, (2) developed worksheet was practical with category scores were good until very good and obtained positive responses from students, and (3) worksheet was effective to improve each aspect of students' creative thinking skills by getting N-gain score with high category, and significant. Based on the results of the analysis and discussion, it was concluded that the guided inquiry and mind mapping strategy-based worksheet was proper to use.

**Keywords:** Guided inquiry, Mind mapping, Creative thinking skills.

## 1. INTRODUCTION

Curriculum development is aimed at producing students who are creative, productive, effective, and innovative through strengthening integrated knowledge, skills, and attitudes. In accordance with these objectives, learning is needed that prioritizes individual experiences through the process of observing, asking, reasoning, and trying (observation of learning) to increase student creativity. Fluency, flexibility, originality, and elaboration are four aspects of in creative thinking [1].

Creative thinking skills can be integrated into the learning process. Efforts that can be made by teachers to achieve this include applying the inquiry learning model. The inquiry learning model can facilitate students to improve their creative thinking skills [2]. Inquiry also refers to activities that students undertake to develop knowledge and understanding of scientific ideas as well as scientists' understanding of studying nature [3].

Mind mapping is an effective and creative way of writing to explore all the brain's abilities in thinking or learning [6]. Mind mapping can train a person to use the brain optimally, both right brain and left brain. The mind mapping strategy requires students to use their creative

thinking skills [7]. The use of mind mapping learning methods has an effect on students' cognitive and affective learning achievements [8]. Worksheet can be in the form of instructions, steps to complete a task. Worksheet can make it easier for teachers to carry out learning and make students learn independently in understanding and carrying out a written task [9]. Therefore, the research focus to develop the guided inquiry and mind mapping-based worksheet to improve students' creative thinking skills.

## 2. METHODS

Development of worksheet used Research and Development (R&D). The research design used one group pre test – post test design [10]. Instruments of this study were validation sheet, learning observation sheet, response questionnaire, and creative thinking skill-mind mapping assessment sheets. Questionnaire, observation and test are the techniques to collect data. Then the data that obtained were analyzed descriptively.

### 3. RESULTS AND DISCUSSION

#### 3.1. Validity

The validity of the developed worksheets reviewed in terms of content and constructs are presented in Table 1.

**Table 1.** Validity of worksheet

Description	Percentage (%)	Category
<b>Content Criteria</b>		
Compatibility of parts with Guided Inquiry and Mind Mapping models	92,5	Very Valid
Able to train students' creative thinking skills	92,5	Very Valid
Clarity of material distribution	92,5	Very Valid
Clarity Numbering system	92,5	Very Valid
Suitability Type and font size	92,5	Very Valid
<b>Construct Criteria</b>		
The material is relevant to the indicators and learning objectives	82,5	Very Valid
Grouped in logical sections	92,5	Very Valid

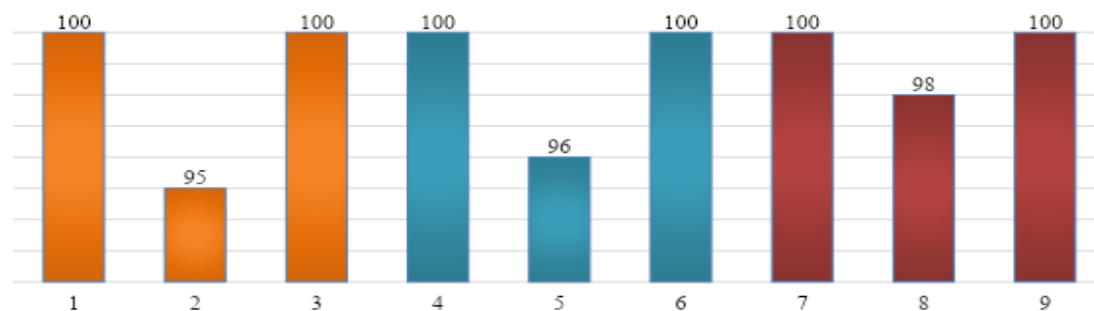
Base on the data in Table 1, criteria of content shown very valid in all aspects. "Clarity of material distribution" categorized as very valid, because the three worksheets that have been developed coherently divided, namely 1st worksheet "the basic laws of chemistry", 2nd worksheet "mole concept", and 3rd worksheet "stoichiometry". The basic law material of chemistry must be understood by students first, because it will always be applied to the next meeting. The mole concept material is given before stoichiometry. This will make it easier for students to determine the amount of substance before or after the reaction. The preparation of the worksheets is based on the book Chemistry Matter and Change [11].

Construct validity was assessed too. The validator considers that the worksheets developed have been grouped into logical parts and the tasks given are in accordance with the order of the material. The percentage in this aspect is 92,5% with a very valid category. Students can understand the material easily. The function

of worksheet, namely as teaching materials concise and so many tasks for practicing [13]. In previous research, worksheet that had been developed is very valid [37].

#### 3.2. The Implementation of Learning

Aspects of the implementation of the lesson plans that were observed included teacher activities in managing the learning process which consisted of preliminary, core, and closing activities. Implementation of learning diagrams in lesson plan 1, 2, and 3 are presented in Figure 2.



**Figure 1** Diagram of learning implementation.

The implementation of lesson plan in 1<sup>st</sup>, 2<sup>nd</sup>, and 3<sup>rd</sup> meeting obtain percentage with very good categories. This is because the guided inquiry syntax is applied coherently. In every phase or syntax of guided inquiry train students' creative thinking skills, for example in last phase making mind mapping. Make a mind mapping can train fluency, flexibility, originality, and also elaboration. The benefits of mind mapping are helping to remember

material, make students more creative, and make learning faster, easier, and efficient [6].

#### 3.3 Students' Response

Student response data obtained from the results of the questionnaire given to students at the end of the 3<sup>rd</sup> meeting. The recapitulation of the student response questionnaire is presented in Table 2

The results of the student response show that guided inquiry and mind mapping-based worksheet received responses in good and very good categories. Aspect phenomena, descriptions or explanations got the highest percentage, namely 93% of students who stated that they were easy to understand. The phenomenon is in the form of a narrative and is equipped with pictures. The chosen phenomenon is an event/fact of everyday life so that it is not foreign to students. Students will more easily understand a certain concept if the explanation starts

from something easy or something concrete, something real is in their environment [9]. In terms of students' interest in the guided inquiry learning model, as many as 83% stated that they were interested in participating and agreed if the learning was applied at the next meeting. This proves that students are happy and comfortable with learning that encourages them to be active both in discussions and in solving problems such as guided inquiry.

**Table 2.** Student response

Question	Percentage Response (%)	
What do you think about this component?	Interested	Not Interested
1. Teaching Material	97	3
2. Worksheet	97	3
3. Learning material	83	17
4. The way the teacher teach	97	3
5. Stages directed by the teacher in learning	93	7
Do you find it easy to understand the components in the following worksheets?	Easy	Not Easy
1. Material	83	17
2. Phenomenon, description, or explanation	87	13
3. Question	83	17
4. Information	87	13
What do you think about the way teachers provide learning with guided inquiry models and mind mapping strategies?	Good	Not Good
1. Motivate students and inform learning objectives	93	7
2. Guide students to focus on the problem of inquiry	83	17
3. Guide students in formulating hypotheses	87	13
4. Guide students in conducting experiments	90	10
5. Guide students in analyzing experimental data	87	13
6. Guide students in make conclusions	100	0
7. Guide students in doing reflection	87	13
8. Guide students in making mind mapping	87	13
After the lesson, do you feel progress in the following creative thinking skills?	Yes	No
1. Flexibility	83	17
2. Fluency	87	13
3. Elaboration	80	20
4. Originality	80	20

### 3.4 Result of Students' Creative Thinking Skills

The results of the thinking skills test were analyzed for homogeneity test (Table 3), normality test (Table 4), and Wilcoxon test (Table 5).

**Table 3.** Homogeneity test results

		Levene Statistic	df1	df2	Sig.
Value	Based on mean	7.815	1	58	.007
	Based on Median	4.099	1	58	.048
	Based on Median and with adjusted df	4.099	1	33.907	.051
	Based on Trimmed on	6.211	1	58	.016

**Table 4.** Normality test results

		Kolmogorov-Smirnov		
		Statistic	df	Sig.
Value	Pre-test	.173	30	.022
	Post-test	.237	30	.000

Data is homogeneous presented in Table 3, while in Table 4 the data is not normally distributed. Referring to the results of Tables 3 and 4, the statistics used are parametric inferential statistical tests. In this case, the

researcher used the Wilcoxon Signed Ranks Test. Wilcoxon Signed Ranks Test results are in Table 5.

**Table 5.** Results of the Wilcoxon signed ranks test for the value of creative thinking skills.

	Posttest – Pretest
Z	-4.789
Asymp. Sig (2-tailed)	.000

$\alpha = 5\%$

Significant difference between the pre-test and post-test scores shows on Table 5. There is a significant increase in creative thinking skills after the

implementation of guided inquiry and mind mapping-based worksheets, that presented in Table 6.

**Table 6.** Test score and n-gain score of students' creative thinking skills.

Mean of Pre-Test		Mean of Post-Test		N-gain	Category	
Score	Category	Score	Category		High	Medium
10	VLC	79	C	0.77		√

VLC : Very Less Creative; C : Creative

Table 6 shows that at the time of the pre-test, students included in the uncreative category. At the post test, students in the creative category. Students have been able to answer creative thinking skills test questions well, so that the scores obtained by student's increase. Research showed that the inquiry learning model had an impact on students' creativity [4] [5]. It can be seen from the learning process, students have the ability to generate many ideas and expand those ideas. students can also make interesting mind mapping. Mind mapping can make every incoming information will automatically be

associated with all the information that is already in the mind. The more memory links attached to the information, the easier it will be to pull out the required information [6]. When students make mind mapping, the entire hemisphere of the students' brain becomes active so that they are able to show the relationship between separate pieces of information and group concepts and compare them with other concepts. This is what makes students more mastery of the concepts in stoichiometry material and be more creative. The result of N-gain calculation were presented in Table7.

**Table 7.** Enhancement of each component of creative thinking skills.

Component of Creative Thinking Skills	Score		N-gain	Category
	Pre-test	Post-test		
Flexibility	18.23	90.17	0.88	High
Fluency	6.80	92.87	0.92	High
Elaboration	12.47	78.90	0.76	High
Originality	6.47	87.70	0.87	High

N-Gain scores of all the component are on high category. Elaboration obtained the lowest N-gain score, namely 0.76 Elaboration is the ability to develop or expand ideas [14]. This component obtained the lowest increase because students seemed to still have difficulty developing their ideas, including when making mind maps. Some students are still not able to connect the keywords that have been mentioned so that the resulting mind mapping does not cover all the material. Overall, the results obtained at the post-test have increased both

for each student and for indicators of creative thinking skills. This is because the worksheets used at the time of the trial already contain questions that can train creative thinking skills. Students are trained to use 1st worksheet and then repeated until 3rd worksheet, so that students are trained to solve creative thinking skills questions. In accordance with the theory of information processing from the initial processing will go into short-term memory and with repetition of memory students will arrive at long-term memory [12]. The results of this study

are also relevant to the latest research 2019-2021 that the importance of creative thinking skills for students [15-36].

#### 4. CONCLUSION

The conclusion of this research is the guided inquiry and mind mapping-based worksheets developed are valid, practice, and effective so that they are suitable for use in the learning process to improve students' creative thinking skills. The implication of this research is an alternative solution in improving students' creative thinking skills at the junior high school level. The limitation of this study was that it was only conducted in one class. Further research can be carried out in more classes and different materials, as well as at different levels of education

#### AUTHORS CONTRIBUTION

All authors conceived and designed this study. All authors contributed to the process of revising the manuscript, and at the end all authors have approved the final version of this manuscript.

#### ACKNOWLEDGMENTS

Thanks to the State University of Surabaya and the leadership of the in Science Education Postgraduate Programme for supporting me to take part in MISEIC 2021.

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