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Improving the habits of mind of senior high school students toward biology learning through creative problem-solving learning model based on mind mapping: Pre-experimental study

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ABSTRACT

There have been many attempts to improve the habits of mind of high school students in Biology through various learning models. However, only a few research results show efforts to improve students' habits of mind through the creative problem solving learning model with mind mapping techniques. Therefore, the purpose of the study was to determine the effect of the creative problem solving learning model with mind mapping techniques on increasing the habits of mind of high school students in learning biology. The pre-experimental method was used with the one group pretest-posttest design. Involving three research classes with 108 students taken by cluster random sampling and getting the same treatment using the creative problem solving learning model with mind mapping techniques. Research data collection uses essay and habits of mind questionnaires. The implication of this research is to increase students' habits of mind. students become accustomed to using their minds critically, creatively and able to control themselves very well as evidenced by an increase in posttest scores on essay tests and habits of mind questionnaires with an average of 86% and 83% (very good) with an average N-Gain 66% and 52% (medium), so the creative problem solving learning model was recommended to increase the habits of mind of high school students in biology learning.

INTRODUCTION

The challenge of the 21st century is Science, especially Biology because it has a significant contribution to technological development, namely as a basic science that underlies the development of technology. According to (Melani et al., 2019) 21st-century skills are categorized into four things, namely ways of thinking (creativity and innovation, critical thinking, problem-solving, decision making, and learning), ways of working (communication and collaboration in groups). with the opinion expressed by Anderson (in Putri et al., 2020) that 21st-century science learning should ideally be directed to 4 components namely communication, collaboration, critical thinking, problem-solving, creativity & innovation and recommended by BSNP/Depdiknas 2006 learning should be directed at creating an active, critical, analytical, and creative atmosphere through developing thinking skills. Various literature categorizes students' higher order thinking skills including critical thinking, creative thinking, problem-solving, and decision making. Creative thinking and critical thinking are skills that are categorized into the habits of mind indicator, as expressed by Marzano in Susilowati et al. (2018) that habits of mind are categorized into three criteria, namely: (1) self-regulation, (2) critical thinking, (3) creative thinking. Habits of mind are the highest intelligent behavior ability in solving problems and are an indicator of academic success.

Habits of mind is needed in biology learning activities whose learning characteristics are related to how to systematically find out about events in nature, emphasizing mastery of material concepts, principles, facts, and evidence (Sugianto et al., 2021). Habits of mind in biology learning is a useful ability of students to construct and use their knowledge appropriately according to the problems at hand so that students can think effectively during the learning process. Habits of mind helps students to always use their time productively and sharpen the intelligence of students and will have an impact on student learning outcomes (Isfiani, 2016).

The importance of having the habit of thinking or habits of mind in students in learning biology, contrary to the results of observations made on students of class X IPA SMA Negeri 1 Natar, through the distribution of the habits of mind questionnaire from the three indicators to obtain results, namely the self-regulation indicator of 26.47%, critical thinking 11.47%, creative thinking 17.33 %. The achievement of these three indicators is fairly low in the criteria for calculating habits of mind according to Costa and Killicks (Dwirahayu et al., 2018). Based on the results of direct observations at SMA Negeri 1 Natar through interview activities the causes of the low habits of mind due to several factors such as students who tend to be passive in learning activities, educators still dominate in learning activities, educators are less innovative in choosing to learn still more often use the lecture method, question, and answer, and educators are less innovative in choosing learning models in the implementation of teaching and learning activities and as a result, students feel bored and do more other activities and talk about things outside the biology material taught by the teacher. Students also have bad habits, namely, some students are lazy to read their notes again this is because students are accustomed to taking notes by copying existing notes and according to the language used by the author so that the material being studied is difficult to understand which causes students to tend to be passive in carrying out learning, as a result, the learning process becomes disrupted and less effective which causes students ' habits of mind to be classified as low.

Solutions to improve habits of mind can be done by applying learning models and techniques. The learning model is an example of a learning pattern or structure that is designed, implemented, and systematically evaluated by the teacher in achieving learning objectives (Sufairoh, 2016). While the learning technique is a knowledge of how to teach used by teachers to present learning materials to students in the classroom so that lessons can be understood well by students (Suryani, 2022). So that learning can be delivered optimally and the achievement of student learning outcomes can meet expectations in the concept of biodiversity, educators need to carry out learning using learning models and techniques that are following the characteristics of the 2013 curriculum, namely student-centered learning, so that students can freely explore their

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knowledge and convey the ideas they have, therefore the researcher recommends one learning model that can be applied to focus students and change patterns of thinking habits (habits of mind) in learning activities on the concept of biodiversity, namely the creative problem solving (CPS) learning model. The CPS learning model is defined as a habit of thinking and acting in solving a problem. The CPS learning model is a learning model that can focus on teaching and problem-solving skills accompanied by strengthening skills. The selection of the CPS learning model learning model will place students in real conditions because the problems presented are complex and meaningful. Through the creative problem-solving skills of students, it will produce truly meaningful knowledge (Harefa et al., 2020).

The CPS learning model is more perfect in collaboration with the technique chosen by the researcher, namely the Mind Mapping technique which is a creative note-taking technique by combining colours, lines, symbols, and images. The Mind Mapping technique will help students optimally utilize the full potential of their brains and will focus on alternative thoughts that come from the center of the mind as a whole to reach various thoughts from all directions so that it will develop students' creative thinking habits. The development of creative thinking habits will stimulate them to think critically because creative thinking habits involve curiosity in students so it encourages them to ask questions and think to discuss solutions to the problems they face (Ananda, 2019).

Research on the effect of the CPS learning model with the mind mapping technique on habits of mind is still relatively low. This study measures the habits of mind which divides it into three indicators, namely creative thinking, critical thinking, and self-regulation several previous studies that applied the CPS learning model on average were used to measure one of the three indicators. Habits of mind only, creative thinking, for example, or only critical thinking, but in this study, researchers measured three abilities at once which were directly stated in habits of mind. Based on this, researchers are interested in examining the effect of the CPS learning model with mind mapping techniques on the habits of mind of class X students on the concept of biodiversity.

METHODS

The method was used in this study is the pre-experimental method with the one group pretest-posttest design, which is a research method that is classified as a weak experiment because the method only uses treatment samples or experimental classes without any control samples (Farooq, 2016; Stricker, 1967). The researcher doubled the experimental class into two additional classes that applied CPS learning model with mind mapping technique as a comparison class, so this study involved three classes or as many as 108 students as samples taken with cluster random sampling given the same treatment using CPS learning model with mind mapping technique.

The instrument used in this study is the habits of mind essay test which consists of 10 questions and a questionnaire sheet consisting of 20 validated statements. Habits of mind includes three indicators, namely critical thinking, creative thinking, and self-regulation. The data on the results of the essay and questionnaire tests that have been obtained are in the form of pretest, posttest and N-gain scores. The pretest scores were obtained from the results of the essay tests and student questionnaires before receiving the treatment of CPS learning model with mind mapping technique, the posttest scores were obtained from the results of the essay tests and student questionnaires after receiving treatment, while the N-Gain was the result of the analysis of the difference between the average pretest and posttest. The results of the essay test data and the habits of mind questionnaire were then tested for prerequisite analysis consisting of normality, homogeneity, and hypothesis testing.

The habits of mind test had a score range of 0-3 on each aspect. The formula to find out the overall results of habits of mind is as follows:

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$$\text{Habits of mind test results} = \frac{\text{Habits of mind Score x } 100\%}{(\sum \text{Maximum Score})}$$

To find out the habits of mind on each indicator, use the following formula (Dinata & Mulyo, 2019):

$$\text{Percentage (\%)} = \frac{\text{The score for each Habit of Mind indicator x } 100\%}{(\sum \text{research sample x} \sum \text{items})}$$

Data processing from the habits of mind questionnaire can be done using percentage analysis techniques with the following steps (Dinata & Mulyo, 2019):

a. Calculating score
   Score = weight × number of respondents
b. Determine the maximum score
   Score = maximum weight × number of points × number of respondents
c. Determine the percentage score with the formula =

$$\frac{\text{NP = Number of habits of mind questionnaire scores in each aspect x } 100\%}{\text{Total ideal score} \times \text{number of statements}}$$ and categorized using Table 1.

Table 1. Category interpretation of written test and questionnaire scores category presentation

Percentage	Category
81 – 100 %	Very good
61 – 80 %	Good
41 – 60 %	Enough
21 – 40 %	Less
< 21 %	Very less

RESULTS AND DISCUSSION

The results of the normality test with the Kolmogorov-Smirnov test on the N-Gain essay habits of mind value in research class 1 obtained a sig value of 0.200 0.05, research class 2 sig value 0.080 0.05, and in research class 3 obtained a sig value of 0.065 0.05 means that the overall data from the research results of the habits of mind ability test after the normality test is normally distributed. The results of the normality test on the habits of mind questionnaire in research class 1, research class 2, and research class 3 obtained a sig value of 0.200 0.05, meaning that the three classes that have been tested for normality are normally distributed. Then the results of the homogeneity test calculation on the habits of mind essay test obtained a sig value of 0.552 0.05, this means that the research data are homogeneous. Meanwhile, the results of the homogeneity test calculation on the habits of mind questionnaire test obtained a sig value of 0.465 0.05, this means that the research data are homogeneous.

Habits of mind score based on essay test

Researchers used the habits of mind essay questions with 10 questions to measure the cognitive aspects of students getting better. Habits of mind research data in the form of the achievement of initial habits of mind essay scores, late habits of mind, and N-Gain. The results of the habits of mind essay test are presented in (Table 2).

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Table 2. Results of the essay habits of mind for the overall class on the three indicators

No	Indicator	Average value (%)					
		Pretest	Criteria	Posttest	Criteria	N-Gain	Criteria
1.	Critical thinking	59	Enough	89	Very good	73	Tall
2.	Creative thinking	56	Enough	86	Very good	68	Currently
3.	Self-regulation	62	Enough	83	Very good	56	Currently
	Average	59	Enough	86	Very good	66	Currently

Based on the Table 2, it can be seen that the average score of the habits of mind pretest essay on all indicators is 59% with sufficient criteria, posttest score of 86% very good criteria, and N-Gain 66% moderate category. The highest score of essay habits of mind on the concept of biodiversity is the Critical Thinking indicator, which is 89% with very good criteria and the N-Gain score is 73% which is included in the high category. The average score of the posttest on the Creative Thinking indicator is 86% in the very good category and the N-Gain value is 68% in the medium category. Then on the Self-Regulation indicator, the average posttest value was obtained by 83% with very good criteria and the N-Gain value of 56% in the medium category. Based on the data obtained, it means that the increase in habits of mind in the whole class is fairly good, this is evidenced by the acquisition of high and moderate N-Gain scores

Habits of mind based on questionnaire results

Table 3. Results of the essay habits of mind for the overall class on the three indicators

No	Indicator	Average value (%)					
		Pretest	Criteria	Posttest	Criteria	N-Gain	Criteria
1.	Critical thinking	64	Enough	83	Very good	54	Currently
2.	Creative thinking	65	Enough	86	Very good	59	Currently
3.	Self-regulation	64	Enough	80	Very good	44	Currently
	Average	65	Enough	83	Very good	52	Currently

Based on the Table 3, it can be seen that the average acquisition of the habits of mind questionnaire results in the pretest score of 65%, sufficient criteria, and posttest scores. by 83% very good criteria and the N-Gain value of 52% in the medium category. habits of mind consists of three indicators, namely critical thinking which includes two sub-indicators, namely: (1) being open and sensitive and (2) knowing the abilities of friends; the second indicator is creative thinking which consists of two sub-indicators, namely: (1) being involved and (2) making efforts to maximize abilities; and the third indicator is self-regulation which includes two sub-indicators, namely: (1) being aware of their thoughts and (2) making plans effectively. The following is the average value of the results of the habits of mind questionnaire as a whole in the three research classes on each indicator presented in Figure 1, Figure 2, and Figure 3.

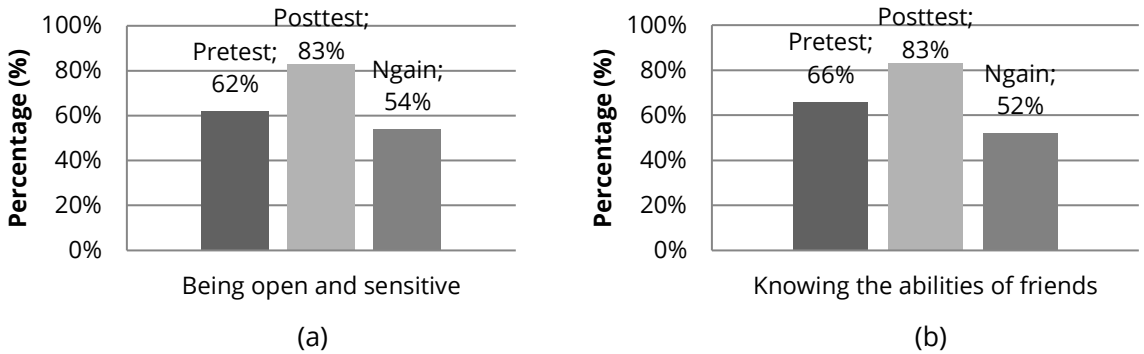

Figure 1. Percentage of habits of mind questionnaire results on critical thinking indicators: a. being open and sensitive; b. knowing the abilities of friends

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The average score of the posttest on the critical thinking indicator listed in Table 2 by 83% in the very good category and the N-Gain value of 54% in the medium category. Based on the diagram above, it can be seen that the open sub-indicator obtained an average posttest score of 83% (very good) with an N-Gain value of 54% which was categorized as moderate. Obtaining the results of the questionnaire on the sub-indicator is sensitive and knows the ability of friends on the posttest score by 83% (very good) with an N-gain of 52% in the medium category.

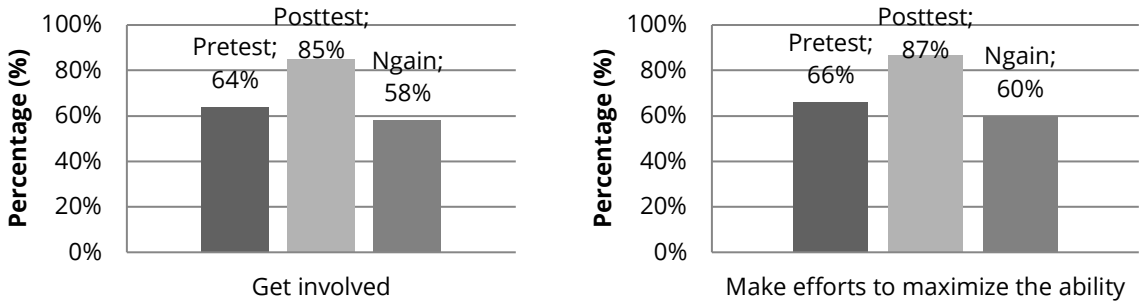

Figure 2. Percentage of habits of mind questionnaire results on creative thinking indicators: (a) being involved; (b) making efforts to maximize abilities

The average score of the posttest on the Creative Thinking indicator listed in Table 2 by 86% in the very good category and the N-Gain value of 59% in the medium category. Based on the diagram above, it can be seen that the acquisition of the average posttest score in the sub-indicator involved 85% which was in the very good category with an N-Gain acquisition of 58% in the medium category, then on the sub-indicator made efforts to maximize the ability to obtain posttest scores by 87% in the very good category and the acquisition of N-Gain by 66% in the medium category.

The average score of the posttest on the Self-Regulation indicator is listed in Table 2 by 80% in the very good category and the N-Gain value of 44% in the medium category. Based on the diagram above, it can be seen that the average posttest score the sub-indicator realizes his thinking is 79% good category with an N-Gain acquisition of 43% medium category, then the average posttest score on the sub-indicator of making plans effectively is 80% which is classified as very good with an N-gain value 44% with moderate criteria.

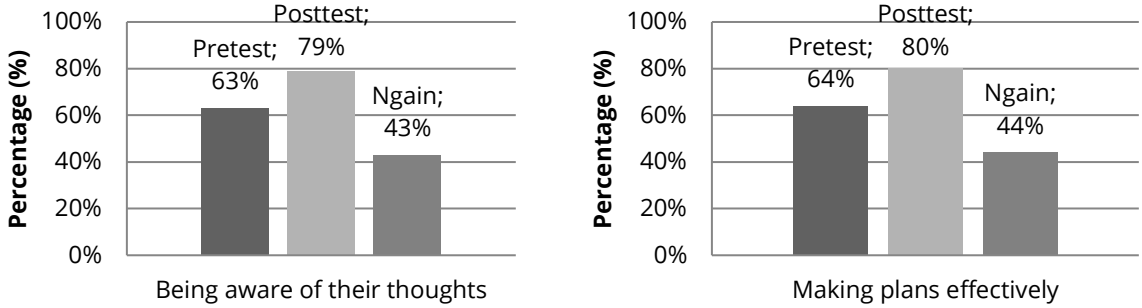

Figure 3. Percentage of habits of mind questionnaire results on self-regulation indicators: (a) being aware of their thoughts; (b) making plans effectively

The value of N-Gain in this study was obtained from the treatment given to students in the form of Mind Mapping-based CPL learning by using three classes simultaneously as one sample with the same treatment. Researchers provide several problems that are outlined in the syntax of creative problem-solving learning models that stimulate students to get used to thinking critically,

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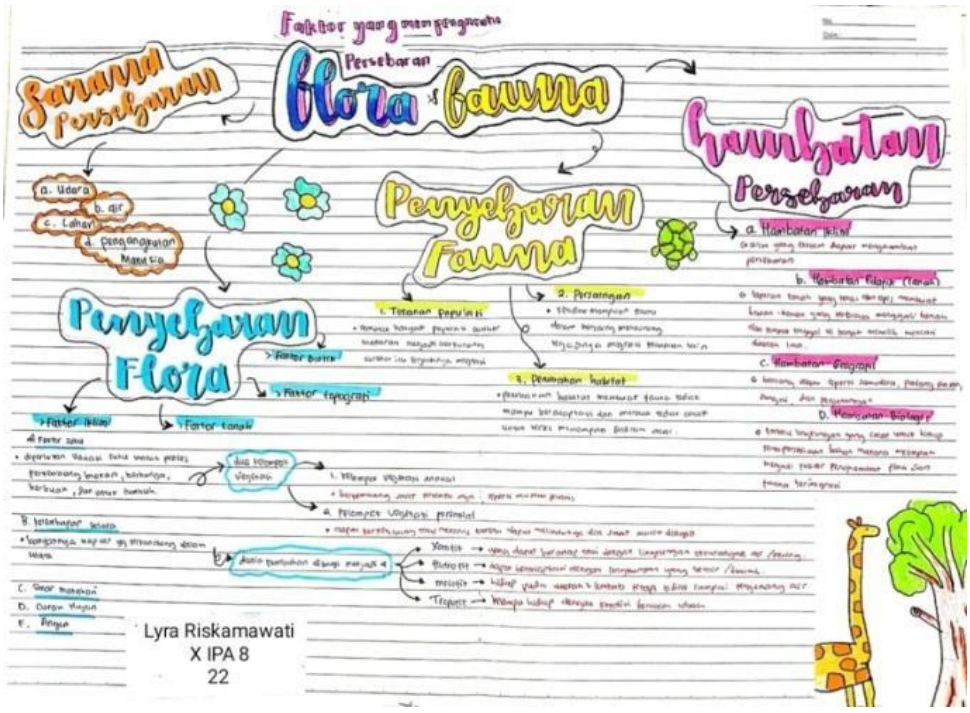
creatively by providing as many ideas and ideas as they have and have good self-control by being aware of their own thoughts through various sources of information they have. use it to solve the problems they face and improve their habits of mind as evidenced by increasing the value of N-Gain.

Results of student mind mapping on the concept of biodiversity

The following picture (Figure 4) shows the results of the Mind Mapping of class X students on the concept of biodiversity.

(a)



(b)

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(c)

Figure 4. Examples of biodiversity mind mapping made by students: (a) three kinds of biodiversity; (b) plant and animal distribution factors; and (c) the uses of biodiversity.

Based on the Figure 4, it can be seen some of the results of students' mind mapping on the material of biodiversity. When viewed from the Mind Mapping, after students received learning treatment with CPL learning model based on mind mapping, students' habits of mind already fairly good, this can be seen from the completeness of the material which is summarized and poured in the form of creative notes or Mind Mapping. Students' critical thinking ability can be seen from the way they choose important points without reducing and covering the entire content of the material which is enough to only make one sheet of paper because one of the indicators of critical thinking ability according to Costa is to explain. simply (Asmawati et al., 2018) it is relevant to the way students summarize the material without reducing the important points that are poured by students on the mind mapping of biodiversity. Creative thinking (Creative Thinking) can be seen from their attractiveness and creativity in mixing and matching lines, colors, symbols, and images into a creative note or mind mapping in the Table above. This is relevant to the opinion (Ginting et al., 2019) which states that creativity is the ability someone in giving birth to something new, in the form of ideas or real works in the form of aptitude characteristics or non- aptitude, as well as a combination of things that already exist that are relatively different from what already exists (Ginting et al., 2019). Their self-control ability (Self-Regulation) can be seen from their independence in making Mind Maps by not cheating on each other and the resulting mind mapping in various forms. Habits of mind. Because, students with good habits of mind will shape students' ability to think and will make students more mastery of new material so that they are freer to use their knowledge and become easier to organize themselves to complete tasks independently (Werdiningsih & Khoerunisa, 2021). Habits of mind indeed support students in everyday life since they are the combination of many skills, attitudes, and past experiences. It means that there are connections between a mindset to another (Hidayati, 2020) and learning with mind maps train student's thinking processes and habits of mind (Gloria, 2020).

Based on the results of the research that has been described as a whole, the use of the CPL learning model based on mind mapping has a positive effect on the habits of mind of students as

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evidenced by the increase in the results of posttest essay tests and habits of mind questionnaires (Table 4).

Table 4. Prerequisite analysis one sample t-test

Indicator	Average value (%)					
	t	df	Sig (2-tailed)	Mean Difference	Lower	Upper
Essay HOM	19,443	107	0,000	0,33724	0,3029	0,3716
Questionnaire HOM	24,708	107	0,000	0,20749	0,1908	0,2241

Based on the Table 4, it can be seen that for the results of hypothesis testing using the One-Sample T-Test test using a significant level (T Value) of 0.31 which comes from the moderate category on the interpretation criteria of the N-Gain value, both in the essay test and the habits of mind questionnaire, both obtain sig value 0.000 ≤ 0.05 then according to the test conditions that H_0 = rejected, H_1 = accepted. This means that there is an effect of the CPL learning model with the mind mapping technique on the habits of mind of students on the habits of mind questionnaire test. Students already have the habits of mind which are stated in the results of the pretest essay and habits of mind questionnaire but are not as high as the habits of mind level after carrying out mind mapping -based CPL learning model. Habits of mind is a potential for students who can improve students' knowledge and thinking skills (Dinata & Mulyo, 2019)

The CPL learning model based on mind mapping can facilitate students exploring ideas and ideas in thinking activities during the learning process so that students' habits of mind abilities can achieve very good criteria on the results of essays and habits of mind questionnaires. This happens because of the effect of CPL learning model which challenges students through creative problem-solving so that students who are faced with a problem become able to implement problem-solving skills, students can freely choose and develop their ideas so that they can expand their thinking process of students. Students (Wahid & Karimah, 2018). Relevant to the opinion (Tumiran, 2020) which states that the application of the CPL learning model will invite students to learn through problem-solving to change and improve students' thinking habits or habits of mind.

Through mind mapping based CPL learning model, students are accustomed to brainstorming activities so that students' ways of thinking change more creatively and critically by thinking about real issues and can predict how to solve problems correctly (Wardani & Izzati, 2017) so that they will also form Self-regulation ability as stated in the HOM indicator is in the form of the ability to be actively related to metacognition, motivation and behavior in learning. The selection of the mind mapping technique combined with the CPL learning model is a collaboration that is very appropriate and suitable in increasing interest learn students' thinking habits (Klassen, 2006; Ng & Ng, 2015). Students with a high interest in learning will have high creative thinking skills which is one of the indicators of habits of mind making it easier to achieve learning goals (Van Tonder et al., 2021). Mind mapping is very effectively used to bring up the hidden ideas that students have, mind mapping is ideal for jumping up students' thinking through forming, visualizing, designing, taking notes, solving problems, making decisions, revising and clarifying main topics so that students can complete assignments even though there are many (Sulfemi, 2019), besides that based on several studies that have been carried out the mind mapping technique has also been shown to increase understanding, creativity, and increase self-regulation of students which includes indicators of habits of mind (Putro et al., 2021). Mind mapping techniques can affect the habits of mind Students because this technique helps students to make the learning process more enjoyable and make learning easier to understand so that the habits of mind of students will increase directly. Mind mapping techniques in learning are used to develop students' abilities in presenting the content of concepts or subject matter through mind mapping which is the most creative and effective way of taking notes that map the minds of students (Thahir & Hambali, 2020) Creative thinking is an ability that provides various possible answers based on

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the information provided to develop a problem into an alternative answer (Febriyanti & Wulandari, 2021). Besides being able to improve Creative Thinking, and Self-Regulation mind mapping can also improve Critical Thinking according to the opinion (Maspupah et al., 2018) which states that developing students' critical thinking skills can be done by giving structured tasks to make Mind Maps instill biological concepts which are expected.

CONCLUSION

Based on the research that has been done, it can be concluded that overall, students who are research subjects who have received learning that applies the creative problem-solving learning model with the mind mapping technique already have excellent habits of mind, this means the Creative Problem-Solving model and mind mapping technique effectively used in learning, especially in learning Biology.

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Authors' Note

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