

Using remap-TmPS learning to improve low-ability students' critical thinking skills

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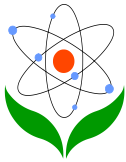
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Abstract



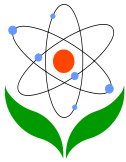
Some research findings showed that Indonesian students' critical thinking skills below average, especially those who have a low academic ability; even though that skills are needed to face this 21st century. There should be a strategy to train students to develop their critical thinking, one of them is by implementing an appropriate learning model. One of the alternatives is Reading-Concept Map-Timed Pair Share (Remap-TmPS) model. This study aimed to find out the effect of Remap-TmPS model and students' different academic ability towards their critical thinking skills on Biology. This research was conducted in Senior High Schools in Batu, East Java, Indonesia. Pretest-Posttest Nonequivalent Control Group Design was employed in this study and 116 students were involved as the participants. There were two experimental classes taught using Remap-TmPs and two control classes taught as well by using conventional learning. Data on students' critical thinking skills were collected using an essay test. The results of the test were assessed using the critical thinking skills' scoring rubric and an ANACOVA test. The research finding showed that students who have the low academic ability in Biology learning who taught by using Remap-TmPS have equal critical thinking skills or the same as students' who have high academic ability who taught by using conventional learning. So, learning Biology using Remap-TmPS can be used as an alternative for students' who have a low academic ability in order to enhance their critical thinking skills.

Keywords: Remap-TmPS, academic ability, critical thinking skills

Introduction

One of the skills that should be mastered in Science learning in the 21st century is critical thinking skills. In other words, science learning process that can improve students' life skills in the 21st century is a science learning that can promote students' critical thinking skills (Saavedra & Opfer, 2012). Critical thinking implementation in Science learning gives an opportunity to develop analytical, inductive, and deductive thinking skills to overcome the problem related to the natural events.

Critical thinking skills constitute a logic and reflective thinking process to make a decision (Ennis, 2011). Critical thinking skills also refer to skills which can be used to evaluate personal or others' opinions (Johnson, 2011), make a decision, and evaluate it through a thinking process. Critical thinking is an active and a well-



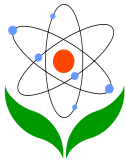
organized mental process, a manifestation of its own thinking by considering other thinking, practicing what has been taught, and aiming to understand the events and conditions surrounding, so that critical thinking is one of the vital elements of scientific thinking. This is also imaged as an order to direct a mind which shows intellectual skills. Critical thinking skills are needed to develop in the school learning through Science or other disciplines to prepare students to be successful in their life (Schafersman, 1991), in other words, students' critical thinking skills should be taught explicitly (Zubaidah, 2016, 2017).

Students who have good critical thinking skills have been proven to be able to solve problems (Marin & Halpern, 2011) since they can better focus on finding a solution to the problem by analyzing it holistically (Finken & Ennis, 1993). Muhfahroyin (2009a) stated that the relationship between critical thinking skills and learning is to prepare students to be the great problem solver, a good decision-maker, and long-life learners. Since the importance of critical thinking skills, it is supposed to be merged with curriculum to give students a benefit for their daily life.

Critical thinking skills are important to develop in the school learning since it has a positive impact to the students' learning outcome, meaning that students who have good critical thinking skills will get the better learning outcomes (Cano & Maryinez, 1991). Critical thinking skills are needed to prepare students to enter the work life and in the middle of society (Hove, 2011). Besides, students who have critical thinking skills will also be easier in problem solving (Marin & Halpern, 2011). An individual who has critical thinking skills will tend to have a better focus, be able to find reasons and do an analytical action at overall when drawing the conclusion in problem solving (Finken & Ennis, 1993).

Students' Thinking Skills on Biology in Indonesia were Still Low

Critical thinking skills in Indonesia has been developed since a long time ago, even in 2003 curriculum is more assertive for teachers to apply the learning strategy to empower students' higher order thinking skills and their assessment processes, one of them is critical thinking skills (Permendikbud No 21, 2016). However, in the implementation, the teachers often less focus on empowering their students' critical thinking skills because, in the process of development, it takes more times. Heong (2011) reveals that if critical thinking skills is not an indicator in succeeding the

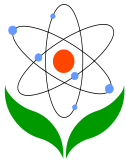


students, it will affect students when they are in a university. The students often meet the difficulty in identifying a complex problem.

Some research results showed that critical thinking skills in some school in Indonesia are less-empowered, such as shown later. Kusuma's research (2014) in Junior High Schools in Malang, Insyasiska (2013) and Ismiati (2011) in SMAN Batu, and also Tumbel (2012) in Bitung City in North Sulawesi showed that critical thinking skills in Senior High School were still low. Research done by Rosyida et.al (2016) showed that opinions and questions raised by students still pertained as LOTS (lower order thinking skills). The research result of Kurniawati et.al (2015) in Batu City also showed that 60% of students in Senior High School had less-developed critical thinking skills. Based on their survey, Mahanal, Tendrita, Ramadhan, Ismirawati, and Zubaidah (2017) found out that high-ability students' critical thinking skills were higher than low-ability students' critical thinking skills.

Students' low critical thinking skills in Indonesia was caused by a learning activity in High School and University (including Science and Biology learning) which is not consciously empowered high thinking skills (critical thinking, creative thinking, and meta-cognitive thinking skills) (Corebima, 2016). Science learning in Indonesia was still dominated by the teachers and did not actively engage the students (Fuad, Zubaidah, Mahanal, Suarsini, 2017; Zubaidah, Fuad, Mahanal, & Suarsini, 2018). Prayitno, Corebima, Susilo, Zubaidah, & Ramli (2017) point out that Science learning in Indonesia is still focusing in a rote learning or concept memorization as well and the measurement of success is still based on how big the scientific products (concept, theory, law) can be mastered and remembered by students who are lack of chance in developing their critical thinking skills. Even, it is not only critical thinking skills is less-empowered but also learning at schools tends to focus on improving students' cognitive achievement, while students' attitudes tend to be ignored (Bachtiar, Zubaidah, Corebima, & Indriwati (2018).

Other problems happened in many schools in Indonesia was a students admissions system determined on the basis of students' level of academic ability (Yusnaeni, Corebima, Susilo, & Zubaidah, 2017). This caused that some schools got many students who have high academic ability while other certain schools got the students who have the low academic ability. The impact of it caused a social gap, for instance, there is a different critical thinking skills among schools. The schools which have



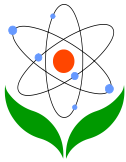
students' high academic ability tended to have good critical thinking skills. Meanwhile, the school which has students' high academic ability tended to have less-developed critical thinking skills.

Some problems have been explained needed to have a learning strategy in the classroom that can be used to decrease the differences among those schools. One of the alternative ways that can be used to close that social gap is by implementing an appropriate learning model.

The Academic Ability is Related to Critical Thinking Skills

The academic ability is an image of prior knowledge had by students or material mastering which have been studied and uses to make it easier in learning a new, wider and more complex knowledge (Mahanal & Wibowo, 2009). Vernon (2000) suggests that a person who has a high academic ability commonly has a high speed of learning as well. A prior knowledge is believed as a required condition for the development of critical thinking skills (Lai, 2011). A prior knowledge has a significant role in achieving students' performance and students' convergent thinking skills is closely related to their prior knowledge (Chang, 2010). The thinking skills are not a series of skill that can be directly taught and implemented by students, but it is needed a deep knowledge of the subjects. Therefore, critical thinking skills and scientific skills cannot be separated from context or depend on knowledge domain (Willingham, 2016)

Teachers are expected to train students' critical thinking skills because critical thinking skills is an important attribute in intellectual development, knowledge acquisition and the utilization of knowledge in individuals (Kong, 2006). The various literature showed that the learning strategy which promoted critical thinking skills is a teaching activity that needs students' actively engagement or student-centered. A learning strategy such as problem-based learning, reflective journal writing, mind-map composing and a debate were reported that can improve students' critical thinking skills (Yang & Chou, 2008), because those strategies can help in students' engagement in a learning activity and support them to have a critical thinking disposition such as a curiosity, analytical ability, reasoning skill, self-confidence and open-minded (Gul, et al., 2014). Johnson and Johnson cited in Alansari (2006) showed that the cooperative learning outcome can enhance a retention, a deep

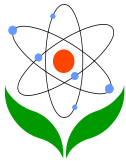


understanding of high-level reasoning and a critical thinking. Kronberg & Griffin (2000) train students to the high level of critical thinking skills through Biology by using problem-analysis methods, and resulted in students who have a high level of critical thinking skills.

Remap-TmPs to Improve Students' Critical Thinking skills

Learning models and academic abilities may influence students' low critical thinking skills. The students' critical thinking skills might be able to develop if they are facilitated with a good learning model (Mamu, 2014). Some schools in Indonesia have recruited their students based on grades. Therefore, there is such a huge gap between schools in which students are registered to. An alternative to minimize the gap is by implementing Reading-Concept-Map Timed-Pair-Share (Remap-TmPS) learning model in the classrooms, which will be explained in other section.

Remap-TmPS learning model belongs to one of the Reading-Concept Map-Cooperative Learning (Remap Coople) models. Remap Coople's model consists of reading activity, concept mapping, and cooperative learning (Pangestuti, Mistianah, Corebima, & Zubaidah, 2015; Zubaidah, 2014; Mahanal, Zubaidah, Bahri, & Dinnuriyah, 2016). Some previous research findings of Remap Coople using other learning types had enhanced critical thinking skills, a cognitive learning outcome, and a reading interest as explained follows. The implementation of Reading Concept Map-Teams Games Tournament (Remap-TGT) could enhance the tenth graders' reading interest of SMA Laboratory Malang (Pangestuti, et.al., 2015). The implementation of Reading Concept Map-Student Team Achievement Division (Remap-STAD) could improve students' critical thinking skills and cognitive learning outcome (Hasan, Zubaidah, & Mahanal, 2014; Ramadhan, Mahanal, & Zubaidah, 2016). Antika's research (2015) revealed that students' reading interest in Biology using Reading Concept Map-Think Pair Share (Remap-TPS) gave the contributions to students' cognitive learning outcome. Setiawan, Zubaidah, dan Mahanal (2015) showed that there was a significant increase in students' reading interest and metacognitive skill after implementing Remap-TPS. Remap-TPS increased the students' learning outcome (Tendrita, 2017). A research did by Mahanal et.al, (2016) showed that the implementation of learning model in Biology using Reading Concept Map-Numbered Heads Together (Remap-NHT) gave an effect to students' critical thinking skills (Kurniawati, Zubaidah, & Mahanal, 2016; Mahanal,



Avila, & Zubaidah, 2018). The implementation of Remap-GI could enhance students' learning outcome and critical thinking skills (Prasmala, Zubaidah, & Mahanal, 2014). The implementation of Remap-Reciprocal Teaching could enhance students' critical thinking skills (Sholihah, Zubaidah, & Mahanal, 2016). The implementation of Remap-TPS could improve critical thinking skills of students who have low academic ability was equal to those who have a high academic ability (Zubaidah, Tendrita, Ramadhan, & Mahanal, 2018).

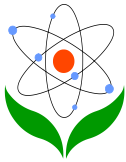
In the learning activity of Remap Coople model, students are asked to 1) read at home, 2) make a concept map, and 3) be cooperative in learning, with some of the following reasons.

Reading activity

A reading activity is a complex process which requires readers to remember and reflect their prior experiences to construct the meaning of the text (Liaw, 2007). In constructing the understanding from texts, the readers are required to have an ability to distinguish facts and opinions; understanding implicit meaning, finding the details related to the problem to discuss; understanding causal relationship between events and actions; detecting the inferential relationship from details observed; being a perceptive reader from many points of view; making moral consideration and fair judgment; and the most important is implementing what they have learned to other domain or a real life (Tung & Chang, 2009).

A reading activity is a cognitive effort engaging a reader interaction, text, and activity (Yousefi, 2016); when reading, a reader takes a look at the text as verbal representation from writer's thought. The reader attempts to enter the writer's point of view. The reader attempts to construct writer's thought on their mind (Paul & Elder, 2002). Elder & Paul (2004) stated that "to study well, a student must read well". Cook assumes that a reading activity as a thinking process and highlights the importance of engaging students to retell the text they have read (Hosseini, Khodaei, Sarfallah, & Dolatabadi, 2012). Thus, the reading activity can be defined as the reader is trained to think critically.

Concept mapping

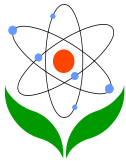


Constructing concept maps in this research is a way to engage students to retell the material they have read. Paul & Elder (2014) stated that a reading activity requires knowledge maps to understand the system of thought. A concept map is a tool that can be a representative of knowledge structure by illustrating the relationship among relevant concepts in the knowledge domain. During the construction of concept maps, students draw concepts related to a certain domain and are asked to relate these concepts in a knowledge framework hierarchically (Novak & Gowin 1984). By connecting and combining a new knowledge with the existed knowledge framework, students can develop a deep and richer understanding and better use of knowledge (Harris & Alexander 1998). Hariyadi, Corebima, Zubaidah, and Ibrohim (2018) revealed that a mind map, the other form of a concept map, has a great contribution towards the students' understanding.

A concept map has been used as an effective tool to teach and learn (Cañas et.al., 2004), since this is also a valuable thing to represent, visualize, and measure individual's knowledge, who facilitates a learning assessment. This concept map is based on learning theory of Ausubel about a meaningful learning (Novak & Cañas 2008). A meaningful learning is signed by integrating a concept and new propositions using relevant ideas with some substantive ways an individual's cognitive structure. According to Mayer (2002), a meaningful learning happens when students build a knowledge and cognitive process required for problem-solving. The meaningful learning requires critical thinking skills in the process of repeated refinement. The fact that building a concept map involves a meaningful learning shows that a concept map is a good tool to enhance critical thinking skills.

Cooperative Learning with Remap-TmPS Model

Johnson & Johnson (1999) stated that cognitive learning facilitates students to study in a small and heterogeneous team to solve problems. Slavin (2005) emphasizes that cooperative learning facilitates students to help each other in a group to understand certain concepts. A cooperative learning builds a learning atmosphere involving students to study together in a small team to achieve their learning goal. Therefore, a cooperative learning supports students with various prior experiences to work and learn in a small team so they can help each other to achieve their learning goal.



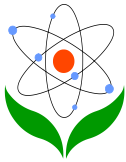
A cooperative learning used in this research is Timed Pair Share (TmPS). As explained above, Remap Coople learning has these activities: 1) students are given a reading task at home, 2) students are asked to construct a concept map and 3) students study at classroom using TmPS cooperative learning which has the syntax: 1) students are group in pairs and each student is given number 1 and 2; 2) all students are given a chance to do the test individually in a limited time; 2) students given number 1 has a chance to deliver their answer while those who get number 2 should listen without raising any questions; 3) students given number 2 write their responses related to the answer from students A in a limited time (whether they agree or not with the answer and give the reasons, also should make a conclusion) in a limited time; 4) students deliver their responses in a class discussion forum in a limited time; 5) the teacher can give a reinforcement of material; and 6) in the next question repeating the first step, then in the third step, students alternately change their role as answer delivers and listeners (developed from Nakagawa, 2003). The role change makes each student has the same chance to develop their critical thinking skills.

A study conducted by Rosyida et.al. (2016) indicated that Remap-TmPS learning model could improve students' critical thinking skills, but its effect on students with the low academic ability is still unclear. According to Nakagawa (2003), however, TmPS has a potential to improve the low-ability students' critical thinking skills. Based on the previous elaboration, it is assumed that it requires to investigate the effect of Remap-TmPs learning model and the academic ability towards students' critical thinking skills.

Research Problems

1. Is there a critical thinking skills difference between students' who taught using Remap-TmPs learning and who those taught using a conventional learning?
2. Is there a critical thinking skills difference between students' who have the high academic ability and those who have the low academic ability?
3. Is there an interactional effect between a learning model and academic ability towards students' critical thinking skills?

Research Hypothesis



1. There is a significant difference in critical thinking skills between students' who taught using Remap-TmPs learning and who those taught using a conventional learning.
2. There is a significant difference in critical thinking skills between students' who have the high academic ability and those who have the low academic ability.
3. There is an interactional effect between a learning model and academic ability towards students' critical thinking skills.

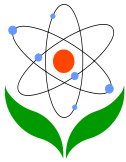
Research Method

Research Design

This research used quasi-experimental research The Pre-test and Post-test Nonequivalent Control Group Design (Beaumont, 2009), to investigate the Remap-TmPS on students' critical thinking skills. This study was conducted on September until November 2015 in public Senior High Schools at Batu, East Java, Indonesia. Schools were chosen based on Minimum Passing Level of National Exam (MPL NE) while the student's academic ability level was determined by using equality test with multiple choice system consisting of 20 questions about Biology in general.

Participants

The participants of this research were all students with an average age of 16 years old from science class X in Senior High Schools in Batu, Indonesia. The research participants were the students from science class X 3 and X 4 of SMAN 1 Batu, and the students from science class X 2 and X 3 in SMAN 2 Batu with the total number of 116 students. To categorize the students into high and low groups, a multiple-choice test was administered. The scores were analyzed using a single ANAVA and SPSS. Random sampling technique was used to select the samples. The election of four classes in this research, consisting of two classes of students who have the low academic ability and two classes of students who have the high academic ability. Two classes were with the same ability. Each of them was divided into two learning models, one class as experimental group taught using Remap-TmPS and one class as



a control group taught using a conventional learning. The experimental classes were given a reading task before they studied at class, constructing the concept map, and at the face to face learning, the teacher implemented a Remap-TmPS learning model with the steps as mentioned in the introduction. The control classes taught by using a conventional learning model, namely, lecture method and students' presentation and discussion. Before and after the learning process, all the class either experimental classes or control classes were given pre-test and post-test. The learning process was conducted in twelve meetings. One of the writers was as a teacher, either in experimental or control class.

Research Instrument and Data Analysis

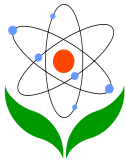
The research instrument consisted of 10 essay items developed on the topic of bacteria and Protista. The results of the test were evaluated using the critical thinking skills' scoring rubric developed by Zubaidah (2014) which is based on Finken and Ennis (1993) which had been published by Zubaidah, Corebima, Mahanal & Mistianah (2018). Before testing the hypothesis data using ANACOVA, the first thing done was completing the requirements which are normality test (Kolmogorov-Smirnov test) and homogeneity test (Levene's test) with $p > 0.05$ (Keselman et al., 1998). Normality test of students' critical thinking skills was 0.166, and the homogeneity test of students' critical thinking skills was 0.059. The collected data were analyzed to know the effect of Remap-TmPS learning model towards students' critical thinking skills in different academic ability.

Research Findings

The results of the ANACOVA test on students' critical thinking skills are summarized in Table 1.

Table 1. The Results of ANACOVA Hypothesis Testing of Students' Critical Thinking skills

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Learning Model	12150.463(a)	4	3037.616	24.812	.000
Intercept	20879.377	1	20879.377	170.547	.000
XB Critical	120.367	1	120.367	.983	.324



Model	7912.793	1	7912.793	64.633	.000
AA	3830.058	1	3830.058	31.285	.000
Model * AA	180.807	1	180.807	1.477	.227
Error	13589.277	111	122.426		
Total	179130.219	116			
Total Average	25739.740	115			

Information.

XB Critical = Critical thinking skills post-test

AA = Academic Ability

Model * AA = Interaction model of Remap-TmPS learning model with the academic ability

Df = Degree of freedom

F= F-counting

Sig= Significance

Based on the hypothesis test result which related to Remap-TmPS learning model and academic ability would be got p-level smaller than alpha 0.05 ($p < 0.05$) with the significant difference is 0.000 and 0.000 (Table 1). This meant that the first hypothesis is accepted, that there is a significant difference in critical thinking skills between students' who taught using Remap-TmPs learning and who those taught using a conventional learning. So, the second hypothesis is accepted as well, that there is a significant difference in critical thinking skills between students' who have the high academic ability and those who have the low academic ability.

Based on the hypothesis test result of learning interaction with the academic level, the score of p-level is bigger than alpha 0.05 with the significant difference is 0.227. Therefore, the third hypothesis is not accepted, that there is no significant interactional effect of learning model and different academic ability towards students' critical thinking skills. In other words, there is a significant effect between learning model and academic ability towards students' critical thinking skills, yet there is no interactional effect of learning model with the different academic ability towards students' critical thinking skills. Even though there is no significant effect, it should be tested in the next step to see combination group position using Least Significant Differences test(LSD) which is shown in Table 2.

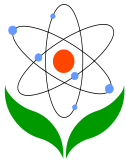


Table 2. The Results of the LSD Test on the Effects of the Interaction between the Learning Model and Students' Academic Abilities on Students' Critical Thinking skills

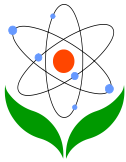
Model	AA	Group	XB-Critical	YB-critical	Difference	B-Critical-cor	Notation
1=conventional	1= low	1	11.54	24.09	12.56	24.34	A
1=conventional	2= high	2	14.82	33.88	19.06	33.51	B
2=Remap-TmPS	1= low	3	12.44	38.40	25.96	38.48	B
2=Remap-TmPS	2= high	4	12.45	52.66	40.21	52.74	c

The results of the LSD test indicate that the low-ability students' critical thinking skills improved by Remap-TmPS so they can be at the same level as the high-ability students' critical thinking skills promoted using conventional learning. The students' pretest and post-test mean scores are depicted in Table 3.

Table 3. The Students' Pre-Test and Post-Test Mean Scores

No	Learning Variable	Pretest	Posttest	Difference	Mean of Corrected Scores	Improvement (%)
1.	Conventional	13.18	28.99	15.81	28.93	119.97
2.	Remap-TmPS	12.44	45.53	33.09	45.61	265.92
3.	High academic	13.63	43.27	29.64	43.13	217.37
4.	Low academic	11.99	31.25	19.26	31.41	160.68
5.	Conventional-HA	14.82	33.88	19.06	33.51	128.75
6.	Conventional-LA	11.54	24.09	12.56	24.34	108.85
7.	Remap-TmPS-HA	12.45	52.66	40.21	52.74	323.04
8.	Remap-TmPS-LA	12.44	38.40	25.96	38.48	208.75

Table 3 shows that students' critical thinking skills have improved after they learned using Remap-TmPS learning (mean score = 45.61) compared to they learned using conventional learning (mean score = 28.93). The students' critical thinking skills promoted by Remap-TmPS learning increase at 265.92% while the students' critical thinking skills promoted by conventional learning increase at 119.97%. These figures suggest that Remap-TmPS learning model could significantly improve students' critical thinking skills.



The Table 3 also shows that the high-ability students could achieve better (mean score = 43.13) than the low-ability students (mean score = 31.41). The high-ability students' critical thinking skills have improved by 217.37%, while the low-ability students' critical thinking skills only improved by 160.68%. These numbers indicate that the high-ability students performed better in critical thinking skills compared to the low-ability students.

Based on the analysis results presented in Table 3, through Remap-TmPS known that the mean score of academic achievement of the highest academic class is 52.74 and the improvement is 323.04%. Meanwhile the through Remap-TmPS known that the mean score of academic achievement of the low academic class is 38.48 and the improvement 208.75% and through conventional it is known that the mean score of academic achievement of the highest academic class is 33.51 and the improvement 128.75%). Meanwhile, through conventional, it is known that the mean score of academic achievement of the low academic class is 24.34 and the improvement 108.85%. The percentages show that Remap-TmPS learning could significantly increase the high-ability and low-ability students' critical thinking skills compared to conventional learning. The improvement of the students' critical thinking skills is presented in Figure 1.

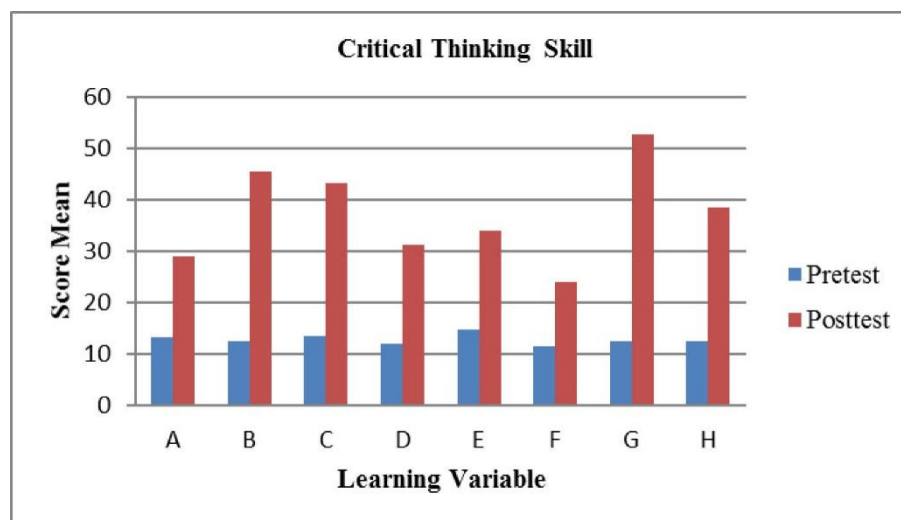


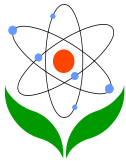
Figure 1. The Improvement of Student' Critical Thinking skills

Notes of figure:

A: Conventional
B: Remap-TmPS

D: Low Academic (LA)
E: Conventional-HA

G: Remap-TmPS-HA
H: Remap-TmPS-LA



C: High Academic (HA) F: Conventional-LA

Discussion

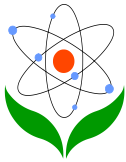
The Effects of Remap-TmPS on Students' Critical Thinking skills

The results of the ANACOVA test show that there is a difference in critical thinking skills found between students taught using Remap-TmPS and those taught using conventional learning. This research finding is in line with the results of a study conducted by Dinnurriyah (2015) using Remap-NHT (Reading-Concept Map-Numbered Heads Together); Mahanal et al. (2016); Sholihah et al. 2016) using Remap-RT (Reading-Concept Map-Reciprocal Teaching); and Rosyida, et al. (2016) using Remap-TmPS which indicate students taught by using Remap Coople had better critical thinking skills compared to students taught using conventional learning. Since Remap-TmPS has a learning syntax which can help promote students' critical thinking skills, it can be considered as one of the alternatives to teach biology to the students.

Reading can empower students' critical thinking skills. Through reading, students are trained in how to analyze, synthesize, and justify the information found in a text in order to understand it (Widuroyekti, 2006). Davies (1997) stated that a reader will think critically when s/he needs to agree or disagree with a particular idea presented in a text.

Remap-TmPS learning requires students to read at home. Therefore, before coming to the classroom, they will bring some concepts to discuss. The discussion will lead students to sort, analyze, and evaluate the information or knowledge. This process includes students' critical thinking skills (Duron, Limbach, & Waugh, 2006; Fascione, 2013). Therefore, the more the students read, the better they are in processing information. The information can be also used by the students to make a decision (Pujiono, 2012). A reading activity can also enhance critical thinking skills in line with the research findings from Mistianah et al., (2015) which stated that by reading, students can train their ability to think critically through reading for meaning.

The students can learn from a book and change their perception towards a particular idea. To formalize the knowledge, the students need to write a concept map (Handoko,

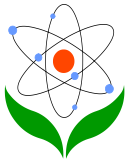


Nursanti, Harmanto, & Sutrisno, 2016). Due to limited access, the construction of concept map done manually by students used papers and pens. To support the 21st century skill, the construction of concept map can be done by using ITC and the programs such as i-Mind Map, Cmap Tools, Freemind, Mind Manager or other programs, since technology has an important role in developing the knowledge (Handoko, Smith, & Burvill, 2014).

A concept map is a graphical tool which describes a relationship between a certain concept with another concept arranged hierarchically and connected with lines (Novak, 2003). Concept mapping allows students to train their critical thinking skills by finding connections between concepts (Vanides, Yin, Tomita, & Ruiz, 2005; Ling & Boo, 2007; Karakuyu, 2010; and Novak, 2010). A concept map can help students to have a better conceptual clarification of a concept (Cheema & Mirza, 2013). This research findings were in line with the research done by Pangestuti, et.al., (2015) with her Remap-TGT learning model, Prasmala (2014) with Remap-GI learning model, Hasan (2014) with Remap-STAD learning model and were proved that the learning activity using this concept map can improve students' critical thinking skills.

Remap-TmPS learning model also allows students to perform cooperative learning in the classroom, but they are still asked to work individually. The individual activity can help to improve the students' critical thinking skills (Surayya, Subagia, & Tika, 2014). A discussion might be initiated after a student shares his/her ideas with other groups. When the student is speaking, other students may underline some important points and be prepared to provide responses to them. Rosyida et al. (2016) state that when the students are asked to cite the responses, they put a lot of efforts to make their explanation understandable. Therefore, they need to think critically to find the best way to present their ideas. Their partners were thinking critically to make their friends quickly understand their explanation.

The last step of Remap-TmPS learning is to let students recite their ideas in front of the classroom. While a student is delivering his/her speech, others may take notes. They also need to evaluate others' responses towards learning problems discussed. This activity leads the students to be a critical thinker since they need to construct a concept to provide appropriate responses. The construction towards friends' responses is empowering the students' critical thinking skills in finding the correct



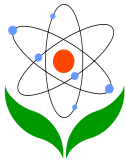
answers. The research done by Sampsel (2013) showed that a discussion can unite the thoughts to find a concept or conclusion is one of the activity in empowering critical thinking skills.

The Effects of Students' Academic Abilities on Students' Critical Thinking skills

Based on the results of the ANACOVA test, it can be concluded that the high-ability students' critical thinking skills are better than the low-ability students' critical thinking skills. Tindangen (2006) and Mahanal (2009) suggest that the level of critical thinking skills possessed by the high-ability students is different from the level of critical thinking skills possessed by the low-ability students although they are taught the same learning strategies. Furthermore, Mamu (2015) reported that the high-ability students will perform better in critical thinking skills compared to the low-ability students. The difference in the students' critical thinking skills might result from the difference in their intelligence which is reflected in their academic abilities.

Corebima (2005) reports that high-ability students will achieve better than low-ability students because the high-ability students obtain information quickly, even faster than the low-ability students do. In fact, the students' initial knowledge will influence their critical thinking skills (Ismaimuza, 2010). Therefore, the high-ability students' critical thinking skills are better than the low-ability students' critical thinking skills (Mahanal, 2009).

Critical thinking is a process which involves mental operation such as induction, deduction, classification, and reasoning (Muhfahroyin, 2009a). Critical thinking is related to high order cognition thinking like analyzing, synthesizing, and evaluating (Fuad et al., 2015). The significance of critical thinking for the students' potential improvement should be considered by teachers to plan and conduct learning that can improve students' thinking skills and conceptual understanding (Mamu, 2015). Critical thinking is a cognitive process and higher order thinking activity performed to get the knowledge (Liliasari, 2000). This critical thinking process activates the ability to analyze and evaluate evidence, identify questions, make a logical conclusion, and understand an argument implication (Friedrichsen, 2001; Muhfahroyin, 2009b). A thinking process will involve analyzing, criticizing, and



making a conclusion based on an inference or careful consideration (Ibrahim & Nur, 2000).

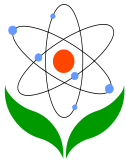
Remap-TmPS learning model can help students to learn from their peers and ask others' favors by discussing, sharing ideas or contributing to solving problems given by the teacher. The high-ability students can work together with the low-ability students. The scaffolding process in a group is beneficial for the students when they are asked to do academic tasks (Mamu, 2015). The high-ability students can play a role as a tutor and the low-ability students can learn from them.

The students also improve their critical thinking skills by connecting their existing knowledge with new information they get in the classroom (Ampuni, 1998). The students' basic understanding can be combined with the new information to better understand a concept (Manzilatusifa, 2008).

The Effects of the Interaction of Learning Model and Students' Academic Abilities on Students' Critical Thinking skills

The results of the ANACOVA test indicate that the interaction of learning model and students' academic abilities has no effect on the students' critical thinking skills. In a similar fashion, Mamu (2014) and Mahanal (2009) report that learning model and academic ability interaction does not influence students' critical thinking skills. However, the results of the LSD test suggest a similar notation of the combination of Remap-TmPS and low academic ability and the combination of conventional learning and high academic ability. It explains that the low-ability students taught using Remap-TmPS could have the same level of critical thinking skills as the high-ability students taught using conventional learning. Despite the similarity, the mean score suggests that the combination of Remap-TmPS and low academic ability is higher than the combination of conventional learning and high academic ability.

The highest mean score is obtained by the combination of Remap-TmPS and high academic ability, while the lowest mean score is indicated by the combination of conventional learning and low academic ability. Therefore, it can be interpreted that Remap-TmPS learning is better in improving students' critical thinking skills compared to conventional learning. Unlike the conventional learning, Remap-TmPS learning consists of reading activity, concept mapping, and cooperative learning



which provide an opportunity for the students to develop their critical thinking skills. One way to improve students' critical thinking skills is by applying an appropriate learning method (Corebima, 2006). That learning method can enable the students to think actively about the learning process (Schafersman, 1991).

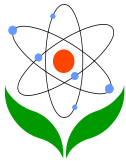
In Remap-TmPS learning, the students have similar chance to improve their critical thinking skills. During the discussion in the class, all students will be provided with the same opportunity to share as an informant or a listener. While linking the concepts, the students are also allowed to improve their language competence which also belongs to one of the critical thinking skills (Finken & Ennis, 1993).

Students who play a role as the listener will process information delivered by the informant. This thinking process leads to the improvement of their critical thinking skills. The high-ability and the low-ability students will have the same chance to analyze and evaluate answers before making a conclusion. They will perform their critical thinking skills in sorting relevant information. Thus, the teacher must assist the students in doing the activities by implementing a students' centered learning model to promote the students' critical thinking skills (Mahanal et al., 2016).

The results of the research suggest that 1) Remap-TmPS learning model is better in improving students' critical thinking skills compared to the conventional learning model, 2) the low-ability students can achieve better in critical thinking skills than the high-ability students because they were taught using Remap-TmPS. These findings indicate that Remap-TmPS could be used to empower students' critical thinking skills despite their different academic abilities.

Conclusion and Suggestions

Based on the research findings, it can be concluded that 1) Remap-TmPS can enhance students' critical thinking skills, 2) the difference of high and low academic ability affects the students' critical thinking skills and 3) there is no interaction between Remap-TmPS learning model towards students' different level of academic ability. The research findings also showed that Remap-TmPS can increase the low-ability students' critical thinking skills to the same level of critical thinking skills possessed by the high-ability students taught with the conventional learning. In

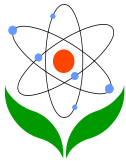


biology classrooms, Remap-TmPS can be considered as one of the alternatives to improve students' critical thinking skills despite their distinguished academic abilities. Remap-TmPS learning can also be used to improve the low-ability students' critical thinking skills and make them similar to the level of the critical thinking skills possessed by the high achievers.

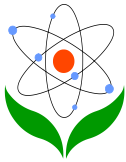
The suggestions for the further researcher, Remap-TmPS learning model can be implemented as an alternative learning activity to empower students' critical thinking, especially for the students who have the low academic ability so that they will have critical thinking skills which are equal or higher than those who have the high academic ability. However, this learning model takes time since the syntax is pretty long. So, it requires a good plan before implementing to make learning activity efficient and not to take more times.

References

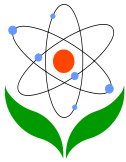
- Alansari, E.M. (2006). Implementation of cooperative learning in the Center for Community Service and Continuing Education at Kuwait University. *Australian Journal of Adult Learning Volume 46*, Number 2, July 2006. Hal 1-10.
- Ampuni, S. (1998). Proses Kognitif Dalam Pemahaman Bacaan. *Buletin Psikologi Tahun VI (Cognitive Process In Reading Understanding. Bulletin Psychology Year VI)*.
- Antika, L. T. (2015). *Hubungan Antara Minat Baca, Keterampilan Metakognitif, & Keterampilan Berpikir Kritis Dengan Hasil Belajar Biologi Berbasis Reading-Concept Map-Think Pair Share (TPS)* (Tesis tidak dipublikasikan). Universitas Negeri Malang, Malang.
- Bachtiar, S., Zubaidah, S., Corebima, A.D., Indriwati, S.E.(2018). The spiritual and social attitudes of students towards integrated problem based learning models. *Issues in Educational Research*. 28(2), pp. 254-270.
- Beaumont, R. (2009). Research Methods and Experimental Design. Handout Course. 1-49.
- Cañas, A. J., Hill, G., Carff, R., Suri, N., Lott, J., Eskridge, T., Gómez, G., Arroyo, M., and Carvajal, R. (2004). CmapTools: A knowledge modeling and sharing environment, Concept maps: Theory, methodology, technology. Proceedings of the first international conference on concept mapping, pp. 125-133.
- Cano & Maryinez. (1991). The Relationship Between Cognitive Performance And Critical Thinking Abilities Among Selected Agricultural Education Students. *Journal of Agricultural Education*, 32(1), 24-29.
- Chang, C-Y. (2010). Does Problem Solving = Prior Knowledge + Reasoning Skills in Earth Science? An Exploratory Study. *Res Sci Educ* (2010) 40, 103–116. DOI 10.1007/s11165-008-9102-0
- Cheema, A. B. & Mirza. M. S. (2013). Effect of Concept Mapping On Students' Academic Achievement. *Journal of Research and Reflections in Education*, 7 (2), 125 -132.
-



- Corebima, A.D. (2005). Pelatihan PBMP (Pemberdayaan Berpikir Melalui Pertanyaan) pada Pembelajaran Bagi Para Guru dan Mahasiswa Sains Biologis dalam Rangka RUKK VA (PBMP Training (Empowering Thinking through Questions) on Teaching for Teachers and Students of Biological Sciences in Order RUKK VA. 25 Juni.
- Corebima, A.D. (2006). Pembelajaran Biologi yang Memberdayakan Kemampuan Berpikir Siswa (Biology Learning Empowering Student Thinking skills). Paper Presented in Training of Metacognitive Strategies on Biology Learning for High School Biology Teachers, Community Service Institutions, Palangkaraya (23 Agustus).
- Corebima, A.D. (2016). Pembelajaran Biologi Di Indonesia Bukan Untuk Hidup. *Proceeding Biology Education Conference*, 13(1), 8-22.
- Davies. (1997). *Introducing Reading*. New York: Penguin English.
- Dinnurriyah, M. S. (2015). *Pengaruh Model Pembelajaran Biologi Berbasis Reading-Concept Map-Numbered Heads Together (Remap-NHT) terhadap Minat Baca, Kemampuan Metakognitif, Keterampilan Berpikir Kritis dan Hasil Belajar Kognitif Siswa Kelas X SMA Malang*(The Effect of Learning-Based Biology Learning Model-Concept Map-Numbered Heads Together (Remap-NHT) to Reading Interests, Metacognitive Ability, Critical Thinking skills and Cognitive Learning Outcomes of Grade X Students of SMA Malang). Unpublished Thesis. Postgraduate of State University of Malang.
- Duron, R., Limbach, B., & Waugh, W. (2006). Critical Thinking Framework For Any Discipline. *International Journal of Teaching and Learning in Higher Education*, 17(2), 160-166.
- Elder, L. & R. Paul, (2004). Critical Thinking and the Art of Close Reading (part IV). *Journal of Developmental Education*, 28(2), 36-37.
- Ennis, R H. (2011). *The Nature of Critical Thinking: An Outline of Critical Thinking Dispositions and Abilities*, Emeritus Professor, University of Illinois, Retrieved from http://faculty.education.illinois.edu/rhennis/documents/The_Nature_of_CriticalThinking_51711_000.pdf.
- Facione, P. A. (2013). *Critical Thinking: What It Is and Why It Counts*, Retrieved from <http://spu.edu/depts/health-sciences/grad/documents/CTbyFacione.pdf>
- Finken, M & Ennis, R. H. (1993). *Illinois Critical Thinking Essay Test*. Department of Educational Policy Studies College of Education University of Illinois 1310 S. 6th St Champaign, IL 61620.
- Friedrichsen, P.M. (2001). A Biology Course for Prospective Elementary Teachers. *Journal The American Biology Teacher*, 63(8), 562-568.
- Fuad, M. N., Zubaidah, S., Mahanal, S., & Suarsini, E. (2015). Profil Hasil Belajar, Keterampilan Berpikir Kritis dan Kreatif Siswa serta Strategi Pembelajaran yang Diterapkan Guru SMP di Kabupaten Kediri (The Profile of Students' Learning Outcomes, Critical, and Creative Thinking skills and Learning Strategy on Junior High School Teachers in District of Kediri). Biology National Conference Proceeding, Mathematics and Science Faculty, Department of Biology, Universitas Negeri Malang, October 17th, 2015.
- Fuad, M. N., Zubaidah, S., Mahanal, S., & Suarsini, E. (2017). Improving Junior High Schools' Critical Thinking skills Based on Test Three Different Models of Learning. *International Journal of Instruction*. 10(1), 101-116
-

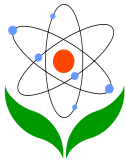


- Gul, R.B., Khan, S., Ahmed, A., Cassum, S., Saeed, T., Parpio, Y., Profetto-McGrath, J., Schopflocher, D. (2014). Enhancing Educators' Skills for Promoting Critical Thinking in Their Classroom Discourses: A Randomized Control Trial. *International Journal of Teaching and Learning in Higher Education*, 26(1), 37-54.
- Handoko, F., Nursanti, E., Harmanto, D., & Sutriyono. (2016). The role of tacit and codified knowledge within technology transfer program on technology adaptation. *ARPN Journal of Engineering and Applied Sciences*, 11(8), 5275-5282.
- Handoko, F., Smith, A., & Burvill, C. (2014). The role of government, universities, and businesses in advancing technology for SMEs' innovativeness, *Journal of Chinese Economic and Business Studies*, 12(2), 171-180. DOI: 10.1080/14765284.2014.900968.
- Hariyadi, S., Corebima, A.D.Zubaidah, S., Ibrohim. (2018). Contribution of mind mapping, summarizing, and Questioning in the RQA learning model to genetic learning outcomes. *Journal of Turkish Science Education*, 15(1), pp. 80-88.
- Harris KR, Alexander PA. (1998). Integrated, constructivist education: Challenge and reality. *Educ Psychol Rev*, 10(2), 115–127.
- Hasan, A. (2014). *Implementasi Model Pembelajaran Reading Concept Map Student Teams Achievement Divisions untuk Meningkatkan Minat Baca, Kemampuan Berpikir Kritis, Kesadaran Metakognitif, dan Hasil Belajar Biologi Peserta Didik Kelas X IPA SMA Insan Cendekia Shalahudin Malang*. Tesis tidak diterbitkan. Malang: Pascasarjana Universitas Negeri Malang.
- Hasan, A., Zubaidah, S., & Mahanal, S. S (2014, Juni). Implementasi Model Pembelajaran Reading Map Student Teams Achievement Divisions Untuk Meningkatkan Kemampuan Berpikir Kritis Dan Hasil Belajar Biologi Peserta Didik Kelas X Ipa Sma Insan Cendekia Shalahudin Malang. Prosiding Seminar Nasional XI dengan tema "Biologi, Sains, Lingkungan, dan Pembelajarannya". Pendidikan Biologi FKIP UNS, 11(1), 810-817
- Heong, M. Y., Othman, B, W., Yonus, M, B, J., Kiong, T, T., & Mohamad, B, M, M. (2011). The Level of Marzano Higher Order Thinking skills among Technical Education Students. *International Journal of Social Science and Humanity*, 1(2), 121-125.
- Hosseini, E., Khodaei, F.B., Sarfallah, S., & Dolatabadi, H.R. (2012). Exploring the Relationship Between Critical Thinking, Reading Comprehension and Reading Strategies of English University Students. *World Applied Sciences Journal*, 17(10), 1356-1364.
- Hove, G. (2011). *Developing Critical Thinking skills in the High School English Classroom*. Retrieved from <http://www2.uwstout.edu/content/lib/thesis/2011/2011hoveg.pdf>
- Insyasiska, D. (2013). Pengaruh Project Based Learning terhadap Motivasi Belajar, Kreativitas, Kemampuan Berpikir Kritis, dan Kemampuan Kognitif Siswa Kelas X Mata Pelajaran Biologi di SMAN 1 Batu (The Effect of Project Based Learning on Motivation of Learning, Creativity, Critical Thinking Ability, and Cognitive Ability of X Class Students of Biology Subject at SMAN 1 Batu). Unpublished Thesis. Malang: Postgraduate Biology Education State University of Malang.
- Ismaimuza, D. (2010). Pengaruh Pembelajaran Berbasis Masalah dengan Strategi Konflik Kognitif terhadap Kemampuan Berpikir Kritis Matematis dan Sikap Siswa SMP (The
-

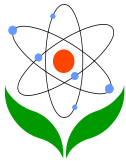


Influence of Problem Based Learning With Cognitive Conflict Strategies on Mathematical Critical Thinking skills and Junior Student Attitudes). *Journal of Mathematics Education*(4 (1):1-10.

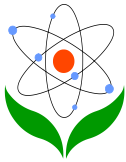
- Ismiati, L. (2011). Pengaruh Strategi Belajar TPS, Reciprocal Teaching, dan Integrasinya terhadap Hasil Belajar Kognitif dan Kemampuan Berpikir Kritis Peserta Didik Berkemampuan Akademik Berbeda di R-SMA-BI Batu (The Influence of Learning Strategy of TPS, Reciprocal Teaching, and Integration of Cognitive Learning Outcomes and Critical Thinking Ability of Different Academic Students in High School in Batu). Unpublished Thesis. Malang: Study Program of Postgraduate Biology Education State University of Malang.
- Johnson D. W. & Johnson, R. T. (1999). Making cooperative learning work. *Theory Into Practice*, 38(2), 67-73.
- Johnson. (2011). Contextual Teaching & Learning Menjadikan kegiatan Belajar Mengajar Mengasyikan dan Bermakna(Contextual Teaching & Learning Make teaching and learning activities fun and meaningful). Bandung: Kaifa.
- Karakuyu, Y. (2010). The effect of concept mapping on attitude and achievement in a physics course. *International Journal of the Physical Sciences*, 5 (6),724-737.
- Keselman, J.H., Huberty, C. J., Cribbie. R. A., Lowman. L.L., Lix, L. M., Donahue, B., Petoskey, D. M., Olejnik, S., Kowalchuk, K. R., Keselman, C. J., Levin, J. R. 1998. Statistical Practices of Educational Researchers: An Analysis of Their ANOVA, MANOVA, and ANCOVA Analyses. *Review of Educational Research*. 68 (3), 350-386.
- Kong, S. L. (2010). Critical thinking for effective teaching and learning. Republic of Singapore: Research Publishing Services.
- Kronberg, J.R., & Griffin. M. (2000). Analysis Problems- A Means to developing Students' Critical-Thinking skills. *Journal of College Science Teaching* 29 (5).
- Kurniawati, Z. L., Zubaidah. S., & Mahanal, S. (2015). Keterampilan Berpikir Kritis Siswa SMA Menegri Kota Batu Pada Metapelajaran Biologi (Critical Thinking skills of Batu State High School Students in Biology Subjects). Proceedings of National Conference and National Workshop on Biology and Secondary Learning of Biology Department FMIPA UM. 1677-1684.
- Kurniawati, Z.L., Zubaidah, S., & Mahanal, S. (2016, Agustus). Model pembelajaran Remap-CS (*Reading Concept Map Cooperative Script*) untuk pemberdayaan keterampilan berpikir kritis siswa. *Proceeding Biology Education Conference, FKIP UNS*, 13(1), 399-403.
- Kusuma, A. S. H. M. (2014). Pengaruh Strategi Pembelajaran RQA, TPS, RQA Dipadu TPS, dan Perbedaan Gender terhadap Keterampilan Bertanya, Kesadaran Metakognitif, Keterampilan Metakognitif, Pembentukan Karakter, dan Hasil Belajar Biologi Siswa Kelas VIII SMP Negeri Kota Malang. Pendidikan Biologi (The Influence of Learning Strategy of RQA, TPS, RQA combined TPS, and Gender Differences on Questioning Skills, Metacognitive Consciousness, Metacognitive Skills, Character Formation, and Student Learning Outcomes of Grade VIII SMP Negeri Malang). Biology Education. Unpublished Thesis. Malang: Postgraduate Biology Education State University of Malang.
-



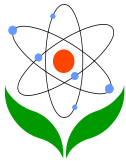
- Lai, E.R. (2011). Critical Thinking: A Literature Review. Research Report. Retrieved from <https://images.pearsonassessments.com/images/tmrs/CriticalThinkingReviewFINAL.pdf>
- Liaw, M-L. (2007). Content-Based Reading and Writing for Critical Thinking skills in an EFL Context. *English Teaching & Learning*, 31.2, 45-87
- Liliasari. (2000). Model Pembelajaran untuk Meningkatkan Keterampilan Berpikir Konseptual Tingkat Tinggi Calon Guru IPA (Learning Model to Improve Conceptual Skills of High-Level Teachers Candidate of Science Teachers). Proceedings of National Conference, Malang, 23 February 2000. Malang: Directorate General of Higher Education-JICA-IMSTEP. 135-140.
- Ling, Y & Boo, H. K. (2007). Concept mapping and pupils' learning in primary science in Singapore. *Asia-Pacific Forum on Science Learning and Teaching*, 8(2).
- Mahanal, S. (2009). Pengaruh Penerapan Perangkat Pembelajaran Deteksi Kualitas Air Sungai Dengan Indikator Biologi Berbasis Proyek Terhadap Hasil Belajar Siswa SMA di Kota Malang (The Effect of Application of River Water Quality Detection Learning Tool with Project Based Biological Indicators to High School Students Learning Outcomes in Malang). Unpublished dissertation. Malang: Biology Education Postgraduate UM.
- Mahanal, S., Avila, S., Zubaidah, S. (2018). Potensi Model Pembelajaran Biologi Berbasis *Reading-Concept Map-Cooperative Script (Remap-CS)* Dan Gender Terhadap Keterampilan Berpikir Kritis Siswa SMA Kota Malang. *Prosiding Seminar Nasional Pendidikan Biologi*(ISBN: 979-602-61265-2-8), Juni 2018. Pp 666-675.
- Mahanal, S., Tendrita, M., Ramadhan, F., Ismirawati, N. & Zubaidah, S. (2017). The Analysis of Students' Critical Thinking skills on Biology Subject. *Anatolian Journal of Instruction*. 2(2), 21-39.
- Mahanal, S., & Wibowo, A.L.P., (2009). Penerapan Pembelajaran Lingkungan Hidup Berbasis Proyek untuk Memberdayakan Kemampuan Berpikir Kritis, Penguasaan Konsep, dan Sikap Siswa (Studi di SMA Negeri 9 Malang. *Prosiding Seminar Nasional*, 20 Juni 2009. Hal 108-118.
- Mahanal, S., Zubaidah, S., Bahri, A & Dinnurriya, Y, D. (2016). Improving Students' Critical Thinking skills through Remap-NHT in Biology Classroom. *Asia-Pacific Forum on Science Learning and Teaching*, 17(2).
- Mamu, H.D. (2014). Pengaruh Strategi Pembelajaran, Kemampuan Akademik dan Interaksinya terhadap Keterampilan Berpikir Kritis dan Hasil Belajar Kognitif IPA Biologi (The Influence of Learning Strategy, Academic Ability and its Interaction on Critical Thinking skills and Cognitive Learning Results of Biology Science). *Journal of Science Education*. 2 (1), 1-11.
- Mamu, H.D. (2015). Profil Keterampilan Berpikir Kritis Dan Metakognisi Siswa Dalam Pembelajaran IPA Biologi Di SMP (Profile of Critical Thinking skills and Metacognition of Students in Biology Science Lesson in Junior High School). *Journal of UNTAD*.
- Manzilatusifa. (2008). Pemberian Motivasi Guru dalam Pembelajaran (Providing Teacher Motivation in Learning). *Journal of Education and Culture*. 5 (2).
- Marin, L.M. & Halpern, D.F. (2011). Pedagogy for Developing Critical Thinking in Adolescents: Explicit Instruction Produces Greatest Gains. *Thinking skills and Creativity* 6(-),1-13.
-



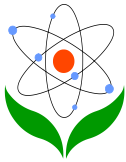
- Mayer, R. E. (2002). Rote versus Meaningful Learning. *Theory Into Practice* (41:4), pp. 226-232.
- Mistianah, Corebima, A. D., dan Zubaidah, S. (2015). *Perbedaan Keterampilan Metakognitif dan Hasil Belajar Biologi antara Siswa yang Diberi Model Pembelajaran Reading Concept Map GI dengan Reading Concept Map Jigsaw di SMA Negeri Kota Malang*. Makalah disajikan pada Seminar Nasional Pendidikan Biologi, Symposium on Biology Education (Symbion) di Universitas Ahmad Dahlan Jogjakarta pada tanggal 4 April 2015
- Muhfahroyin. (2009a). Memberdayakan Kemampuan Berpikir Kritis Siswa melalui Pembelajaran Konstruktivistik. (Empowering Students' Critical Thinking Ability through Constructivistic Learning). *Journal of Education and Learning*. 16(1), 88- 93.
- Muhfahroyin. (2009b). Pengaruh Strategi Think Pair Share (TPS) dan Kemampuan Akademik terhadap Kemampuan Berpikir Kritis Siswa SMA di Kota Metro. (The Influence of Think Pair Share Strategy (TPS) and Academic Ability to Critical Thinking Capability of High School Students in Metro City). *Journal of Education and Learning*. 16 (2), 107-115.
- Nakagawa, J.J. (2003). *Spencer Kagan's Cooperative Learning Structures*, Retrieved from <http://jalt.org/pansig/PGL2/HTML/Nakagawa.htm>.
- Novak J. D., Gowin, D.B. (1984). *Learning how to learn*. Cambridge. UK: Cambridge University Press. pp 15–54
- Novak, J. D. (2003). *Introduction to Concept Mapping The University of West Florida*. Retrieved from <http://uwf.edu/jgould/con ceptmappingintro.pdf>.
- Novak, J. D., & Cañas, A. J. (2008). "The theory underlying concept maps and how to construct and use them," Florida Institute for Human and Machine Cognition.
- Novak, J. D. (2010). Learning, Creating and Using Knowledge: Concept maps as facilitative tools in schools and corporations. *Journal of e-Learning and Knowledge Society*, 6(3), 21-30.
- Peraturan Menteri Pendidikan Dan Kebudayaan Nomor 21 Tahun 2016 Tentang Standar Isi Pendidikan Dasar Dan Menengah. Retrieved from http://bsnp-indonesia.org/wp-content/uploads/2009/06/Permendikbud_Tahun2016_Nomor021_Lampiran.pdf.
- Pangestuti, A. A., Mistianah, Corebima, A. D., & Zubaidah, S. (2015). Using Reading Concept Map Teams Games Tournament (Remap-TGT) to Improve Reading Interest of Tenth Grade Student of Laboratory Senior High School State University of Malang. *American Journal of Educational Research*, 3(2), 250-254.
- Paul, R., & Elder, L. (2002). *Critical thinking: Tools for taking charge of your professional and personal life*. Upper Saddle River, N.J.: Financial Times Prentice Hall.
- Paul, R., & Elder, L. (2014). *The thinker's guide to how to read a paragraph: The art of close reading* (2nd ed.). Tomales, California: Foundation for Critical Thinking Press.
- Prasmala, E. R. 2014. *Penerapan Model Reading Map Group Investigation (GI) untuk Meningkatkan Minat Baca, Kemampuan Berpikir Kritis, Kesadaran Metakognitif, dan Hasil Belajar Biologi Siswa Kelas X SMA Surya Buana Malang*. Tesis tidak diterbitkan. Malang: Pacasarjana Universitas Negeri Malang.
-



- Prasmala, E.R., Zubaidah, S., & Mahanal, S. (2014, Juni). Penerapan Model *Reading Map Group Investigation* (GI) Untuk Meningkatkan Kemampuan Berpikir Kritis Dan Hasil Belajar Biologi Siswa Kelas X Sma Surya Buana Malang. *Prosiding Seminar Nasional XI Pendidikan Biologi FKIP UNS*, 11(1), 835-839.
- Prayitno, B. A., Corebima, D., Susilo, H., Zubaidah, S., and Ramli, M. (2017). Closing the Science Process Skills Gap between Students with High and Low-Level Academic Achievement. *Journal of Baltic Science Education*, 16(2), 266-277.
- Pujiono, S. (2012). Berpikir Kritis dalam Literasi Membaca dan Menulis untuk Memperkuat Jati Diri Bangsa (Thinking Critically in Reading and Writing Literacy to Strengthen the Nation). *Proceeding PIBSI XXXIV*, October 2012,
- Ramadhan, F., Mahanal, S., & Zubaidah, S. (2016, Agustus). Potensi Remap-STAD (Reading Concept Mapping Student Teams Achievement Division) untuk Meningkatkan Keterampilan Berpikir Kritis Siswa. *Proceeding Biology Education Conference*, 2(1), 203-208.
- Rosyida, F., Zubaidah, S., & Mahanal, S. (2015). Kemampuan Bertanya dan Berpendapat Siswa SMA Negeri Kota Batu pada Matapelajaran Biologi (Questioning Ability and Students' Perceptions of State Senior High School in Biology Mathematics). *Proceedings of National Conference and National Workshop on Biology and Secondary Learning of Biology Department FMIPA UM*. 1663-1668.
- Rosyida, F., Zubaidah, S., & Mahanal, S. (2016). Memberdayakan Keterampilan Berpikir Kritis dengan Model Pembelajaran Remap-TmPS (Reading Concept Map Timed Pair Share) (Empowering Critical Thinking skills with the TmPS Remastering (Reading Concept Map Timed Pair Share) model). Paper Presented at the XIII National Conference on Biology Education FKIP UNS.
- Saavedra, A. R. & Opfer, V. D. (2012). *Teaching and Learning 21st Century Skills: Lessons from the Learning Sciences, A Global Cities Education Network Report*, Retrieved from <http://asiasociety.org/files/rand-1012report.pdf>.
- Sampsel, A. 2013. *Finding the Effects of Think-Pair-Share on Student Confidence and Participation. Honors Projects Paper 28*, (Online), (<http://scholarworks.bgsu.edu/cgi/viewcontent.cgi?article=1029&context=honorsprojects>).
- Schafersman, D. S. (1991). *An Introduction to Critical Thinking*, Retrieved from <http://facultycenter.ischool.syr.edu/wp-content/uploads/2012/02/CriticalThinking.pdf>.
- Setiawan, D., Zubaidah, S., & Mahanal, S. (2015, Oktober). Pengaruh Penerapan Model Reading Concept Map Think Pair Share Terhadap Minat Baca, Hasil Belajar, Kemampuan Metakognitif Dan Berpikir Kritis Siswa Kelas X Di Kota Malang. *Prosiding Seminar Nasional Ke-2 Biologi/IPA dan Pembelajarannya Fakultas Matematika Dan Ilmu Pengetahuan Alam Universitas Negeri Malang. Tema: Kemajuan Bioteknologi serta Implikasinya dalam Rekontruksi Kurikulum Pendidikan Biologi*. Malang, Universitas Negeri Malang.
- Sholihah, M., Zubaidah, S., & Mahanal, S. (2016). Remap-RT (Reading Concept Map Reciprocal Teaching) untuk Meningkatkan Keterampilan Berpikir Kritis Siswa (Remap-RT (Reading Concept Map Reciprocal Teaching) to Improve the Critical Thinking skills of Students). Paper Presented at the XIII National Conference on Biology Education FKIP UNS (August) 6, 2016).
-



- Slavin, R.E. (2005). *Cooperative learning*. London: Allyn and Bacon.
- Surayya, L., Subagia, I. W., & Tika, I. N. (2014). Pengaruh Model Pembelajaran *Think Pair Share* terhadap Hasil Belajar IPA Ditinjau dari Keterampilan Berpikir Kritis Siswa (The Effect of Think Pair Share Learning Model on the Learning Outcomes of Science Viewed from the Critical Thinking skills of Students). Retrieved from e-Journal Postgraduate Program of Ganesha University of Education Science Program Volume 4.
- Tendrita, M. (2017). Pengaruh Model pembelajaran Biologi Berbasis Reading-Concept Map-Think Pair Share (Remap-TPS) dan Kemampuan Akademik Berbeda terhadap Keterampilan Berpikir Kritis, Keterampilan Berpikir Kreatif, dan Hasil Belajar Kognitif Siswa Kelas X Kota Batu (Tesis tidak diterbitkan). Pasca Sarjana Universitas Negeri Malang, Malang
- Tindangen, M. (2006). Implementasi Pembelajaran Kontekstual Peta Konsep Biologi SMP pada Siswa Berkemampuan Awal Berbeda di Kota Malang dan Pengaruhnya terhadap Kemampuan Berpikir Tingkat Tinggi dan Kemampuan Berpikir Kritis (The Implementation of Junior High School Contextual Learning Biology Concept Map at Students with Different Prior Knowledge in Malang City and The Influence of High Order Thinking and Critical Thinking skills). Unpublished dissertation. Malang: Biology Education Postgraduate UM.
- Tumbel, F. M. (2012). Pengaruh Strategi Pembelajaran Cooperative Script Dipadu Problem Posing dan Kemampuan Akademik Siswa terhadap Keterampilan Metakognitif, Kemampuan Berpikir Dan Pemahaman Konsep Biologi pada SMA di Kota Bitung Sulawesi Utara (Effect of Cooperative Script Learning Strategy Combined Problem Posing and Student's Academic Ability to Metacognitive Skills, Thinking Ability and Understanding of Biology Concept at SMA in Bitung City of North Sulawesi). Unpublished dissertation. Malang: Biology Education Postgraduate UM.
- Tung, C-A., Chang, S-Y. (2009). Developing Critical Thinking through Literature Reading. *Feng Chia Journal of Humanities and Social Sciences*, No. 19, pp.287-317
- Vanides, J., Yin, Y., Tomita, M., Ruiz, A, M. (2005). Using Concept Map in the Science Classroom. *Science Scope*, 28(8), 27-31.
- Vernon, P.A. (1990). The Use of Biological Measure to Estimate Behavior Intelligence. *Educational Psychologist*. 25 (3&4), 293-304.
- Widuroyekti. (2006). Pengembangan Kemampuan Berpikir melalui Pembelajaran Membaca Kritis di Sekolah Dasar Kelas Tinggi (Development of Thinking Ability through Critical Reading in High School Elementary School). *Didaktika*, 1-14.
- Willingham, D.T. (2016). Knowledge and Practice: The Real Keys to Critical Thinking. *Knowledge Matters*. ISSUE BRIEF #1, March 2016. Retrieved from: www.KnowledgeMattersCampaign.org
- Yang, Y. C., & Chou, H. (2008). Beyond critical thinking skills: Investigating the relationship between critical thinking skills and disposition through different online instructional strategies. *British Journal of Educational Technology*, 39(4), 666-684. doi:10.1111/j.1467-8535.2007.00767.
- Yousefi, S. (2016). Critical Thinking and Reading Comprehension among Postgraduate Students: The Case of Gender and Language Proficiency Level. *Journal of Language*
-



Teaching and Research, 7(4), 802-807, July 2016 DOI:
<http://dx.doi.org/10.17507/jltr.0704.23>.

- Yusnaeni, Corebima AD., Susilo, H., and Zubaidah, S. (2017). Creative Thinking of Low Academic Student Undergoing Search Solve Create and Share Learning Integrated with Metacognitive Strategy. *International Journal of Instruction*, April 2017, 10(2), 245-262.
- Zubaidah, S. (2014). Pemberdayaan Keterampilan Penemuan dalam Scientific Approach Melalui Pembelajaran Berbasis Remap Coople (Empowerment of Invention Skills in Scientific Approach through Coople-Based Remap Learning). *Proceedings of the National Seminar on Biology Education UNS*, 11(1), 1000-1011.
- Zubaidah, S. (2016). Keterampilan Abad ke 21: Keterampilan yang Diajarkan melalui Pembelajaran (21st century skills: Skill that is taught during the lesson) Paper conferenced at National Conference in high school of teaching education and education Perdana Katulistiwa Sintang, Sintang, December 9th. 2016.
- Zubaidah, S. (2017). Contextual Learning based on Solving Problem to Empower Critical Thinking skills (Pembelajaran Kontekstual Berbasis Pemecahan Masalah untuk Mengembangkan Kemampuan Berpikir Kritis.) Paper conferenced at National Conference in Muhammadiyah University of Makasar, Makasar, May 6th. 2017.
- Zubaidah, S., Fuad, M. N., Mahanal, S., & Suarsini, E. (2018). Improving Creative Thinking skills of Students through Differentiated Science Inquiry Integrated with Mind Map. *Journal of Turkish Science Education*, 14(4), 77-91.
- Zubaidah, S., Tendrita, M., Ramadhan, F., Mahanal, S. (2018). Keterampilan Berpikir Kritis Siswa pada Kemampuan Akademik Berbeda Melalui Model Pembelajaran Biologi Berbasis Reading Concept Map Think Pair Share. *Prosiding Seminar Nasional Pendidikan Biologi* (ISBN: 979-602-61265-2-8), Juni 2018. Pp. 162-176.
- Zubaidah, S., Corebima, A.D., Mahanal, S., Mistianah. (2018). Revealing the relationship between reading interest and critical thinking skills through remap GI and remap jigsaw. *International Journal of Instruction*, 11(2), 41-56.