doi: 10.26529/cepsj.777

Using Remap RT (Reading – Concept Mapping – Reciprocal Teaching) Learning Model to Improve Low-Ability Students' Achievement in Biology

Siti Zubaidah*[1], Susriyati Mahanal[1], Mar'atus Sholihah[2], Fatia Rosyida[3] and Zenia Lutfi Kurniawati[4]

The main aim of this study was to investigate the effects of the Remap RT (Reading – Concept Mapping – Reciprocal Teaching) learning model on low-ability students' achievement in biology. This quasi-experimental research made use of a pre-test-post-test non-equivalent control group design. The population of this research was 125 tenth-grade students from the Natural Science classes aged around 16 years old. Four classes were randomly selected as the samples, and they were divided into two groups: two classes belonged to the high ability classes, and the other two were categorised into the low ability groups. The students' achievement was measured using an essay test. The results of the test were analysed using ANCOVA. The findings indicated that 1) students who learned using Remap RT had better academic achievement in biology than students who learned using a conventional method; 2) students with high academic ability had better academic achievement than students with low academic achievement; and 3) low-ability students who learned using Remap RT and high-ability students who learned using a conventional method had equal academic achievement. The results of the research suggest that Remap RT was effective in improving low-ability students' achievement in biology.

Keywords: students' achievement, academic ability, reading ability, concept map, cooperative learning, Remap RT

1 *Corresponding Author. Faculty of Mathematics and Natural Sciences, Universitas Negeri Malang, Indonesia; siti.zubaidah.fmipa@um.ac.id.
2 Faculty of Education, Universitas Islam Balitar, Indonesia.
3 Tuban Public High School 4, Indonesia.
4 Mulawarman University Teacher Training and Education Faculty, Indonesia.

Uporaba učnega modela Remap RT (branje – zaznavanje konceptov – vzajemno poučevanje) za izboljšanje uspešnosti dijakov z nizkimi dosežki v biologiji

Siti Zubaidah, Susriyati Mahanal, Mar'atus Sholihah, Fatia Rosyida in Zenia Lutfi Kurniawati

Glavni cilj raziskave je bil preučiti učinke učnega modela Remap RT (branje – oblikovanje konceptov – vzajemno poučevanje) na uspehe dijakov z nizkimi dosežki v biologiji. Ta kvazieksperimentalna raziskava je uporabila zasnovo s predpreskusom in popreskusom iz neekvivalentne kontrolne skupine. V raziskavi je sodelovalo 125 dijakov desetega razreda iz naravoslovnih razredov, starih približno 16 let. Štirje razredi so bili naključno izbrani v vzorec in razdeljeni v dve skupini: dva razreda sta sodila v skupino z visokimi dosežki, dva pa v skupino z nizkimi dosežki. Dosežki dijakov so bili testirani z vprašanjem esejskega tipa. Rezultati testa so bili analizirani z uporabo ANCOVA. Ugotovitve so pokazale, da so: 1) dijaki, ki so se učili z uporabo Remap RT, dosegli boljše akademske dosežke v biologiji kot tisti, ki so se učili s konvencionalno metodo; 2) dijaki z visokimi dosežki na akademskem področju uspešnejši kot dijaki z nizkimi dosežki; 3) dijaki z nizkimi dosežki, ki so se učili z uporabo Remap RT, in dijaki z visokimi dosežki, ki so se učili s konvencionalno metodo, imeli enake akademske dosežke. Izsledki raziskave kažejo, da je bil model Remap RT učinkovit pri izboljšanju dosežkov dijakov z nizkimi dosežki v biologiji.

Ključne besede: dosežki dijakov, akademski dosežki, sposobnost branja, konceptni zemljevid ali mreža, sodelovalno učenje, Remap RT

Introduction

Due to its importance, students' academic achievement is a constant subject of discussion. It reflects students' mastery of essential skills and also indicates the occurrence of learning. Academic achievement refers to the level of students' academic performance (Shamshuddin, 2007). It is not only related to the knowledge but also the skills that the students have developed after attending a school subject (Ganai & Maqbool, 2016). Niemi (1999) defines academic achievement as the mastery of major concepts and principles, important facts and propositions, skills, strategic knowledge and integration of knowledge. It also refers to students' gained levels in all academic content areas or the status of subject-matter knowledge, understanding, and skills in a determined period. It also portrays students' ability in completing tasks and studies (Kadian, 2016). Students' academic achievement is the result of an educational process that describes the extent to which students, teachers, or institutions achieve their educational goals (Kulkarni, 2016).

Many factors can affect students' achievement. They include instructional strategy or learning model, learning disabilities, demographic factors, home life, and many others that interact with one another. Among the most critical factors that can influence students' achievement (Marzano, 2003), the instructional strategy or learning model should be implemented appropriately. Teachers need to have a sole commitment to decide how to utilise their resources and choose strategies that will promote students' competence (McLeod, Fisher, & Hoover, 2003). How teachers approach their students and how they use different learning strategies have been proven to significantly influence their students' academic achievement (Bolkan & Goodboy, 2009). Studies indicate that teachers' assistance is a crucial factor influencing students' achievement. Teachers can implement learning strategies to guide learning activities and improve students' motivation. In addition to that, students' behaviours can be boosted by explicitly establishing conduct rules in the classroom (Vermunt & Verloop, 1999). Another factor that contributes to students' academic achievement is their academic ability (Busato, Prins, Elshout, & Hamaker, 2000; Veas, Gilar, & Minano, 2016; Veenman & Beishuizen, 2004; Veenman & Spaans, 2005). The higher the academic ability students possess, the faster they learn. Students' high academic ability reflects their good long-term memory and academic achievement. In other words, students with high academic ability are more likely to achieve better than students with low academic ability (Deka, 1993). Diaz (2003) considered low academic ability to be a situation in which a student cannot achieve his/her achievement standard, resulting in an altered personality that affects all other aspects of life. Low-ability students can be described as students whose academic achievement falls below the desired standard.

In general, the distribution of students' academic ability in Indonesian schools remains uneven (Prayitno, Corebima, Susilo, Zubaidah, & Ramli, 2017; Yusnaeni, Corebima, Susilo, & Zubaidah, 2017). This phenomenon occurs due to the new admission system, which allows students' selection based on the Minimum Passing Level of the National Exam (MPL NE), which are the total scores that the students achieved in the final exam on the previous level, as one of the requirements for admission to school at the next level. This system leads to the fact that some schools are composed of low ability or high-ability students only, not a mixture of both (Kurniawati, 2016; Mahanal, Tendrita, Ramadhan, Ismirawati, & Zubaidah, 2017; Ramadhan, 2017; Rosyida, 2016; Sholihah, 2016; Tendrita, 2017).

The emergence of schools that are composed solely of low academic ability students has become a problem in Indonesia. As explained by Deka (1993), low academic ability students will face more difficulties in obtaining good achievement compared to high academic ability students. Therefore, extra efforts are required to assist them in achieving better, one of which is to implement appropriate instructional strategies or learning models. Jacob and Lefgren (2004) found a positive correlation between effective learning and academic achievement. Similarly, Adediwura and Tayo (2007) suggested that effective learning is a significant predictor of students' academic achievement. Akiri and Ugborugbo (2009) also showed that effective learning could produce students who have better performance.

The low academic ability students are expected to be able to obtain equal or almost equal achievement of the high-ability students in a variety of subjects, including biology, which consists of a broad range of material lessons through which students can learn about all living things and their environment. 'Monera' (a kingdom that contains unicellular organisms with a prokaryotic cell organisation, having no nuclear membrane) and 'Protist' (any eukaryotic organism that is not an animal, plant, or fungus) are topics in biology that are considered quite complex for students (Prihartiningsih, Zubaidah, & Kusairi, 2016). Both are difficult to distinguish (Siska, Ardi, & Risdawati, 2016) because the two of them cannot be observed directly with naked eyes. There are many Latin terms and abstract concepts discussed within the topics. As a result, it is difficult for students to learn the topics, and it is more likely that the students will fail to achieve good scores on the exam (Suparoh, 2010).

Even though some biology materials are applicable in everyday life, most of them are, in fact, studied through texts. Students need to read many texts to be able to understand a phenomenon being learned and observed. In addition, varied biology materials (Graesser, McNamara, & Louwerse, 2003) require students to read and develop inference skills to connect concepts in the texts (Hannon & Daneman, 2001). It is evident that this reading ability will assist the students in learning (Ozuru, Dempsey, & McNamara, 2009).

Reading involves active visualisation that contributes to students' ability to memorise a text and understand it and significantly contribute to their achievement as a result (Smajdek & Selan, 2016). Therefore, reading constitutes one of the main activities in a biology classroom, particularly, and all school subjects in general (Kerneza & Kosir, 2016). However, in reality, Indonesian students still have low interest in reading (Hasan, Zubaidah, & Mahanal, 2014; Pangestuti, 2014; Prasmala, Zubaidah, & Mahanal, 2014). According to the Progress in International Reading Literacy Study (PIRLS) in 2011, Indonesia ranked fourth from the bottom on Programme for International Student Assessment (PISA). In 2012, Indonesia ranked second from the bottom (Mullis, 2012).

To overcome these problems, students need to develop a habit of reading materials before the lesson is started. Teachers, in contrast, may evaluate the students' understanding by asking them to create a concept map. Novak (2002) argues that a concept map is an efficient tool that can be used to represent students' knowledge of a concept and specific items arranged in a meaningful hierarchical structure. Through concept mapping, students are able to comprehend knowledge and changes in concepts that have been studied (Daley, 2010). Concept mapping is thus expected to make students remember a number of interrelated concepts they have learned from reading (Pangestuti, Susilo, & Zubaidah, 2014).

Another way to improve students' achievement is to implement cooperative learning in the classroom. Cooperative learning is a situation in which learning occurs between two or more students who work together to complete a task (Siegel, 2005). The advantages of this learning model are to create positive dependency, interaction, and group processing among students and to promote students' individual accountability and social skills (Adams, 2013). Cooperative learning can also improve students' achievement (Alabekee, Samuel, & Osaat, 2015; Buchs, Filippou, Pulfery, & Volpe, 2017; Chen & Liu, 2017; Gull & Shehzad, 2015; Parveen, 2012; Tran, 2014). Cooperative learning facilitates students to do four main activities: summarising, composing questions, predicting, and clarifying answers (Colombo, 2011) and can encourage students to promote social interaction among them, which may motivate them (McKenna, 2002). Cooperative learning is also effective in improving students' reading comprehension and retention (Glynn, Wearmouth, & Berryman, 2005; Padma, 2008).

Reading activity, concept mapping, and cooperative learning are the components of a learning model named Remap Coople, an acronym for Reading - Concept Mapping - Cooperative Learning (Mahanal, Zubaidah, Bahri, & Dinnurriya, 2016; Pangestuti, Mistianah, Corebima, & Zubaidah, 2015; Zubaidah, 2014; Zubaidah, Corebima, Mahanal, & Mistianah, 2018). Each of these components will be explained below.

Reading Activity

Reading in the Remap Coople learning model constitutes the core activity that should be performed by students before meeting in the classroom. The students have to read materials at home, as suggested by the teacher. The students are allowed to select their own time and comfortable way to read, so their knowledge acquisition can be optimal. The teacher only determines themes to read, not the reading sources. The students can find their own reading resources, perhaps scientific books, newspapers articles, comic strips, general knowledge books, and many others. The students are also able to explore various kinds of texts to enrich their knowledge related to materials that are going to be learned in the classroom.

Özbay (2006) explains that reading, in general, can be defined as a method of obtaining new information. Reading can also reflect an individual's ability. It is a mental process resulting from readers' responses to the text (Kardeniz, 2015). Reading is not a single process since a complex cognitive process is occurring inside the readers' mind, including linguistic processes, readers' background knowledge, interpreting, and metacognitive processes (Davies, 1997; Mahakulkar & Wanjari, 2013; Wanjari & Mahakulkar, 2011). Reading stimulates students' thinking process through a set of complex mental activities.

Through reading, students will obtain beneficial knowledge which can improve their logic, social, and emotional growth. Patterson (2016, p. 2) cited the definition of reading from The Michigan Board of Education as 'the process of constructing meaning through the dynamic interaction among the reader's existing knowledge, the information suggested by the written language, and the context of the reading situation'. Akanda, Hoq, and Hasan (2013, p. 6) explain that 'reading as an art provides a human being with the foundation upon which to erect his or her understanding of life as well as the elements with which to build his or her worldview'. Reading also expands an individual's perspective which, as a result, forms his/her new thinking framework. In addition to that, Ögeyik and Akyay (2009, p. 72) emphasise that 'reading is a significant process in ones' academic life which leads towards knowledge. It guides individuals to develop creativity and critical thinking.'

Allington (1984); Chall (2000); Brown, Palincsar, and Purcell (1986) state that students who are not used to reading will frequently face difficulties in understanding texts and have bad scores in all subjects. Lack of reading leads students to the inability to develop reading strategies, which are necessary for all academic fields. Cunningham and Stanovich (1998) state that students who know how to read will read a lot and perform better in various subjects. Therefore, despite the good quality of the new curriculum established by the government, if students are not used to reading, they will still have poor performance in all academic fields. In this situation, students need continuous reading training through which they can develop their reading skills. Schools or teachers are supposed to put forward reading activity in the learning process.

Learning that requires students to read will result in a beneficial knowledge acquisition process (Ogeyik & Akyay, 2009; Ozbay, 2006) and an improvement in students' thinking skills (Zubaidah, 2014). Students who have good thinking skills and abundant knowledge will achieve more because they can read well. They are also able to relate the knowledge with their experiences (El Koumy, 2006). Reading will provide students with prior knowledge that will determine how well they make connections between new concepts learned. It encourages them to assimilate and accommodate the knowledge they have so that they can understand learning materials better and are able to construct knowledge related to it. Students' good understanding will help them to obtain good learning outcomes.

Concept Mapping

The next step of the Remap Coople learning model is concept mapping. Students are required to make a concept map based on what they have read. Since reading activity is performed as homework, this concept map should also be prepared before the students come to the classroom. However, in certain circumstances, the teacher may ask students to do this activity after the lesson ends. Students need to be creative because they are given the freedom to choose their concept mapping style out of variously available concept mapping models or styles (Zubaidah, Fuad, Mahanal, & Suarsini, 2017). The concept map that serves as a summary of the lesson helps students organise their thoughts after reading. Students who manage to generate a concept map will be better at identifying one concept after another, which they obtain from the reading text (Nesbit & Adesope, 2006; Patrick, 2011).

Concept mapping is a tool or a way to arrange knowledge (Novak, 2008). It can be used to describe concepts that students understand and specific items that form a meaningful hierarchical structure. Novak (2008) also suggests that a concept map consists of concepts that are organised in circles or boxes or other shapes and connections that are shown by lines. In short, it can be said that a concept map is a picture that shows a hierarchy of concepts. A concept map can also be considered to be a graphical tool that helps students remember, understand, develop their critical thinking (Santiago, 2011), improve their metacognitive skills, indicate their ability to organise concepts and synthesize information (Vanides, Yin, Tomita, & Ruiz-Primo, 2005), and encourage students to understand and clarify the concepts (Kinchin & Hay, 2000).

Concept mapping is a way for teachers to help their students transfer their knowledge from short-term to long-term memory. Concept maps can assist students in seeing how information, such as ideas and concepts, are structured and connected (Knipper, 2003). Concept mapping is a practical method to monitor students' learning progress (Vanides et al., 2005). Patrick (2011) states that concept maps help students improve and summarise subject matters. Guastello, Beasley, and Sinatra (2000) believe that concept mapping is vital for low achievers because many of them lack prior knowledge of content topics. The implementation of concept mapping in biology has been researched and proven to improve students' higher order thinking and achievement (Antika, 2015; Dinnurriya, 2015; Hariyadi, Corebima, Zubaidah, & Ibrohim, 2018; Mahanal et al., 2016; Pangestuti, 2014; Setiawan, Zubaidah, & Mahanal, 2015). McCloughlin and Matthews (2017) also state that concept mapping plays a significant role in promoting meaningful biology learning.

Cooperative Learning and Reciprocal Teaching (RT) Model

After reading and concept mapping, students are involved in cooperative learning activities in the classroom, which creates a learning atmosphere that allows students to interact with each other in small groups to do the tasks and to achieve the same goals (Parker, 1994). The cooperative learning activities are developed based on information-sharing in groups, which makes students responsible for their own learning and improves other students' motivation (Kagan, 1994). Johnson and Johnson (1999) state that cooperative learning facilitates students learning together in small heterogeneous groups to solve problems. Slavin (2005) also emphasises that cooperative learning makes students help each other to understand learning materials in groups. Therefore, it can be concluded that cooperative learning is a learning model that allows students from different abilities and background to work together in small groups so that they can help each other to achieve their shared goals.

The cooperative learning model selected in this research is reciprocal teaching (RT), which has been developed to improve students' reading ability and provide interactive learning. According to Palincsar and Brown (1984), RT activities include summarising (self-review), questioning, clarifying, and predicting. RT can be implemented for three purposes (McAllum, 2014). *First*, it is a framework for explicit instruction, which provides a framework for clear and detailed learning that does not confuse students. To achieve this purpose, the teacher uses RT to overcome student problems, such as low interest in reading. The teacher, together with the students, will predict, clarify, ask about, and summarise reading texts. *Second*, it is a process for interactive engagement, which involves students in learning interactively. Therefore, the teacher and students need to create a discourse that empowers the students. RT, in this case, has a positive effect on students' reading ability, content acquisition, and motivation. The *third* purpose is to provide an inclusive practice. RT is intentionally designed as a learning model that helps problematic students to understand texts. RT is also able to develop students' self-regulatory skills so that they can participate well in learning and be independent.

Some research findings have proven that RT combined with other models is also effective in improving students' achievement and reducing the gap between high and low-ability students. Suratno (2010) integrated RT and jigsaw learning models in senior high school, and the results show that the combination of these models can improve students' achievement and the closer distance of students' achievement between lower and higher ability students. Efendi (2013) combined RT with Think Pair Share (TPS) models and found that the integration of both resulted in better student achievement than among the students that learned by only the RT or the TPS separately, and the most low-achieving were those taught by conventional learning. Sukardi, Susilo, and Zubaidah (2015) combined RT with concept mapping, and the results of their studies indicated that such combinations are useful in developing students' metacognitive skills and achievement in biology. Marthaliakirana (2014) integrated RT with Reading Questioning Answering models and demonstrated that these combinations improve students' metacognitive ability, achievement, and retention. Warouw (2009) combined RT with Cooperative Script and found that it not only improved students' metacognitive skills but also has a positive effect on their retention.

Some research reveals that the implementation of the Remap Coople learning model has the potential to improve students' achievement (e.g., Hasan et al., 2014; Dinnurriya, 2015; Mistianah, Corebima, & Zubaidah, 2015; Tendrita, Mahanal, & Zubaidah, 2017). Therefore, in this study, RT is combined with reading and concept mapping, as described previously.

Method

Research Objectives

The current study aimed to investigate: 1) the effects of the Remap RT learning model on students' achievement; 2) the effects of students' academic ability on students' achievement; and 3) the effects of the interaction between the Remap RT learning model with students' academic ability on students' achievement.

Research Design

The quasi-experimental research employed a pre-test-post-test non-equivalent control group design. This study was conducted from September to November 2015 in the 2015/2016 academic year on the high and low academic ability students from two public Senior High Schools (SMA) in Batu, Indonesia. Four classes participated; the first two consisted of students with low academic ability categorised into one experimental class and one control class. Similarly, the other two consisted of students with high academic ability categorised into one experimental class and one control class. The Remap RT learning model was carried out in the experimental class. The experimental groups of students were asked to read learning materials prior to the classroom meeting, compose a concept map, generate questions, predict the answers, and clarify their answers through a group discussion held in the classroom.

Meanwhile, the control classes were taught using conventional learning methods. They were asked to learn from lectures given by the teachers and students' presentations and discussions. Before and after the study, the two class groups (i.e., the experimental class and the control class) were given pre-tests and post-tests. The pre-test was administered to all participants prior to the treatment, while the post-test was conducted at the end of the experiment.

Population and Sample

The research population was all tenth graders from natural science classes of public Senior High Schools in Batu, Indonesia, aged approximately 16 years. The research samples were four classes with a total number of 125 students. A random sampling technique was employed to select the participants. Schools were selected based on the MPL NE (Minimum Passing Level of National Exam) while the levels of students' academic ability were determined by using an equality test that consisted of 20 items of general biology knowledge.

The first step to determine low and high academic classes is to conduct an equality test on the students' MPL NE. A one-way ANOVA and LSD test were then performed to decide which schools had different academic levels. The results were made as a reference to select the school samples: public senior high school (SMAN) 1 Batu (high academic) and SMAN 2 Batu (low academic). An ANOVA test was conducted to decide the number of representative classes from each school. As a result, two control classes and two experimental classes were selected.

Data collection and Data Analysis

Data obtained in this research were students' achievement on 'Monera and Protist'. The data was collected using an essay test, i.e., pre-test and post-test performed at the beginning of the study and at the end of the study, respectively. Those tests consist of 10 questions, and the scores were analysed using ANCOVA (covariate analysis) followed by a post hoc LSD (Least Significance Difference) test. Before the ANCOVA was performed, the normality and homogeneity test was carried out. The normality test used One-Sample Kolmogorov-Smirnov, and the homogeneity test used Levene's Test.

Results

The ANCOVA results are presented in Table 1, while the average score of the pre-test and the post-test, the mean scores, and the improvement of students' achievement are presented in Table 2. The results of the ANCOVA shows that the $F\text{-}_{count}$ was 104.482 with a p-value = .000, p-value <α (α = .05). This number means that there was a difference in students' achievement between those who learned using Remap RT learning model and those who learned using conventional methods. Table 2 shows that the mean score of the students' achievement in the conventional classroom (36.33) was lower than that of the Remap RT (52.72). These figures indicate that students who learned using Remap RT achieved better results than those who learned using conventional methods.

Table 1

The Results of the ANCOVA Analysis on the Effects of the Treatments on Students' Achievement in Biology

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Learning Model	14978.617(a)	4	3744.654	46.757	.000
Intercept	16794.588	1	16794.588	209.701	.000
XCLO	64.857	1	64.857	.810	.370
Model	8367.761	1	8367.761	104.482	.000
Academic level	5127.423	1	5127.423	64.022	.000
Model * Academic level	1407.155	1	1407.155	17.570	.000
Error	9610.573	120	80.088		
Total	**270767.713**	**125**			
Total Average	**24589.190**	**124**			

Table 1 shows that the value of $F\text{-}_{count}$ of the difference in students' academic ability was 64.022 with a p-value = .000, p-value <α (α = .05), which means that there was a difference in students' achievement between the high-ability students and low-ability students. Table 2 shows that the mean score of the low-ability students' achievement was 33.38, and of the high-ability students were 39.27. These figures suggest that the high-ability students had significantly higher achievement than the low-ability students did.

Table 2

The Students' Pre-test and Post-test Scores

No.	Variable	CLO		Difference	CLO-COR	Enhancement (%)
		Pre-test	Post-test			
1	Conventional	21.13	36.32	15.19	36.33	71.87
2	Remap RT	21.42	52.74	31.31	52.72	146.17
3	Low Academic Ability	22.07	38.16	16.09	38.06	72.89
4	High Academic Ability	20.48	50.90	30.42	50.99	148.48
5	Conventional LAA	20.00	33.24	13.24	33.38	66.19
6	Conventional HAA	22.26	39.39	17.13	39.27	76.98
7	Remap RT LAA	24.14	43.07	18.93	42.73	78.43
8	Remap RT HAA	18.71	62.40	43.70	62.70	233.55

Note. LAA = Low Academic Ability; HAA = High Academic Ability.

Table 1 also shows that the value of F-$_{count}$ of the interaction between the learning model and students' academic ability is 17.570 with p-value = .000, p-value <α (α = .05) which indicates that there is a difference in students' achievement due to the interaction between learning model and students' academic ability.

The results of the LSD test on the effects of the interaction between learning model and students' academic ability on students' achievement were presented in Table 3, which shows that the low-ability students in the conventional classroom had the lowest achievement, while the high-ability students in the Remap RT classroom had significantly higher biology achievement.

Table 3
The Results of the LSD Test on the Effects of the Interaction between Learning Model and Students' Academic Ability on Students' Biology Achievement

MODEL	Academic Level	GROUP	XCLO	YCLO	DIFFERENCE	CLO-COR	LSD Notation
Conventional	Low	1	1	20.00	33.24	13.24	a
Conventional	High	2	2	22.26	39.39	17.13	b
Remap RT	Low	3	3	24.14	43.07	18.93	b
Remap RT	High	4	4	18.71	62.40	43.70	c

From Table 3, it can be interpreted that the low-ability students who learned using the Remap RT learning model could catch up with other high ability groups who learned by conventional learning. Based on the gap found between the mean of pre-test and post-test scores, the low-ability students were proven to be able to achieve better than the high-ability students in the conventional classroom could. It indicated that the Remap RT learning model had great potential to increase the low-ability students' achievement.

Discussion

The Effects of Remap RT Learning Model on Students' Achievement in Biology

Research findings have revealed that students who learned using the Remap RT learning model could achieve better results than students who learned using conventional methods. This result is consistent with several studies, such as those of Efendi (2013) on RT-TPS (Reciprocal Teaching-Think Pair Share) learning, Adhani (2014) on RT learning, and Dinnurriya (2015) on

Remap NHT (Numbered Heads Together) learning, which have proven the effectiveness of the learning models in improving students' achievement.

The improvement of the students' achievement after the implementation of the Remap RT learning model was presumably induced by the learning syntax, which included reading, mapping concepts, asking questions, predicting and clarifying answers steps. Remap RT provided an opportunity for the students to construct their own knowledge. It led the students to understand learning materials better. The students' background knowledge can be interpreted as learning and experiences that a student has gained in the past (Arleen, 2010). Students gain these experiences in many ways, such as reading, watching television, taking part in a discussion, conducting experiments, viewing objects or demonstrations, field trips, among other ways. Even though factors such as students' interests, teachers' interaction, and the difficulty of the content play roles in how students learn materials, prior knowledge is still necessary (Marzano, 2004).

The reading and summarising included in the concept mapping of Remap RT learning model allow the students to understand learning materials prior to the face-to-face learning activities in the classroom. Indeed, the students were able to better understand and master the concepts being studied through reading (Palincsar & Brown, 1984). What the students obtained from reading would become their prior knowledge. Reading also has the potential to transform the students' explicit knowledge into tacit knowledge (Fuad, Zubaidah, Mahanal, & Suarsini, 2016; Handoko, Nursanti, Harmanto, & Sutriono, 2016). Moreover, with the implementation of the Remap RT learning model, the students became more accustomed to reading and, as a result, developed a reading habit that also influenced their achievement (Owusu-Acheaw, 2014).

The students prepared themselves before coming to the classroom with reading so that it was easier for them to understand the concepts taught by the teacher in the classroom. The concept mapping of the Remap RT learning model can be used to evaluate students' understanding of a certain concept (Novak & Canas, 2008). Concept mapping has been proven to help students understand, integrate, clarify concepts they learned, and improve their achievement (Brinkerhoff & Booth, 2013; Chiou, 2008; Ogonnaya, Okafor, Abonyi, & Gamma, 2016). In addition to manual concept mapping, some applications can be utilised for concept mapping, such as Mind Manager, Freemind, Cmap Tools, and others. Technology and knowledge cannot be separated because they play a significant part in knowledge building (Handoko, Smith, & Burvill, 2014).

The activities of composing questions and predicting the answers also help the students improve their achievement. Students who are already familiar with a particular learning material would be able to compose some critical questions and also can predict the answers. Questions are a tool that can be used to enhance students' thinking skills (Lubliner, 2004). King (1991) explained that composing questions and predicting the answers can help students pay more attention to the problem-solving process, monitor their understanding, and encourage them in solving their problems. Predicting the answer can train students to solve problems by utilising their knowledge. Students' knowledge will be meaningful if it is applied in various situations (Palincsar & Klenk, 1991). Through these activities, students will feel challenged to be able to understand the materials in order to make correct predictions. These will result in the improvement of their achievement because the students must work hard to understand the learning materials.

Clarifying answers is the last step of Remap RT, which also helped improve the students' achievement. When the students clarify their answers, they simultaneously evaluate and revise particular concepts. Students' ability in clarifying answers can be measured from how the students respond to mistakes made, how they revise, and how they complete the answers based on the concepts learned (Palincsar & Brown, 1984). This condition will indirectly improve students' achievement. Therefore, Remap RT learning model has a higher potential for improving students' achievement than conventional methods do.

The Effects of Students' Academic Ability on Students' Achievement in Biology

The results of this research reveal that high-ability students could achieve better results than the low-ability students could. This finding is in line with the results of the research conducted by Suratno (2009), Adhani (2014), and Mamu (2014). Newman-Ford, Lloyd, and Thomas (2009), state that students who have high qualifications upon entering a new school level will consistently achieve higher than students who have a low qualification will.

Academic ability is one of the predictors of students' academic success (Chamorro-Premuzic & Arteche, 2008; Veas, Gilar, & Minano, 2016). Students' achievement will vary according to the levels of their academic ability (Anderson & Pearson, 1984). This might happen due to their different pace of learning (Vermon, 1990). In line with this, Corebima (2005) also suggests that high-ability students can acquire a deeper conceptual understanding than low-ability students can.

Surprisingly, the results of this research indicated that the low-ability students taught using RT Remap could achieve the same or even better results than the high-ability students taught using conventional methods could. This significant finding suggests that an appropriate learning model could turn the table around. Marzano (2006) states that under controlled circumstances, a teacher has an ability to boost students' learning. Therefore, the teacher needs to become knowledgeable of appropriate strategies to help students produce better learning outcomes (Erickson, 2008).

The Effects of the Interaction between Learning Model and Students' Academic Ability on Students' Achievement in Biology

The results of the research show that the interaction between the learning model and academic ability affected students' achievement. This finding is corroborated by those of Efendi (2013) and Widayati (2015), who reported that the interaction between the learning model and academic ability affected students' achievement. The implementation of Remap RT and high academic ability had a positive effect on students' achievement. It was proven that the high-ability students who learned using the Remap RT learning model could achieve significantly higher than other students could. As previously explained, learning activities in Remap RT can facilitate students to understand concepts they are learning (Brinkerhoff & Booth; 2013; Chiou, 2008; Palincsar & Brown, 1984; Palincsar & Klenk, 1991; Ogonnaya et al., 2016). The enhancement of the conceptual understanding will also increase their achievement. With a faster learning pace (Anderson & Pearson, 1984; Newman-Ford et al., 2009), the high-ability students who learned using Remap RT will achieve better than other groups of students will.

The most notable finding is that the low-ability students taught using Remap RT could achieve the same level or even better than the high-ability students taught using conventional methods could. The Remap RT syntax provided the students with activities which helped them develop their reading skills, concept mapping skills, and thinking skills.

Reciprocal Teaching (RT) is a cooperative learning model that has the ability to encourage what is known as 'deep learning'. Springer, Stanne, and Donovan (1999) reported the results of a large meta-analysis on small group learning compared to traditional lecture-based instruction. They determined that various forms of small group learning resulted in students' higher achievement in test scores, more positive attitudes, and higher levels of persistence. However, the result did not occur simply because students were placed in groups. Instead, it resulted from carefully sequenced planned assignments and activities orchestrated by a teacher committed to student learning. The teacher can ensure that students learn important course content through pre-class reading and concept mapping, formative in-class quizzes or classroom examinations, brief in-class activities completed individually, with a partner, or in small groups, and so forth.

Academic achievement and classroom learning are intrinsically related. Understanding learning mechanisms also enhance academic achievement. Teachers need to design classroom activities and encourage students' intellectual companionship and attitudes toward learning that build a sense of responsibility and community for each other (Bachtiar, Zubaidah, Corebima, & Indriwati, 2018). These activities may take the form of students' solving problems together by depending on each other through summarising, asking questions to clarify explanations, making some predictions about possible answers and suggesting different solutions. Therefore, it is necessary for teachers to understand that there are still many low achievers who have not gained certain experiences that would provide them with background knowledge adequate for learning some new materials (Chall, 2000). Teachers have to assess students' needs and use learning models that are aligned with the evaluated needs. Apparently, students do not learn much just by sitting in the classroom listening to the teacher, memorising pre-packaged tasks, and presenting answers, but they need to express what they are learning, write about it, relate it to experiences, and apply it to their daily life.

Conclusions and Implications

The results of this research indicated that students who learned using Remap RT had better achievement in biology than those who learned using conventional methods. Even though the high-ability students could perform better than the low-ability students could, the low-ability students could catch up with them through the implementation of Remap RT. Therefore, the Remap RT learning model can be recommended as one of the effective learning models that can improve the low-ability students' achievement.

The findings of the research can also be used for consideration by schools about whether to accept new students. The recent student admission system using MPL NE leads to the tendency that some public schools would prefer students with high scores of a national examination, or high academic ability students. In contrast, some schools can only accept low academic ability students or students who achieve low scores in the national examination. As a result, the aspect of equality in obtaining a proper education does not receive much attention. Therefore, with the findings of this research, schools are also expected to consider the percentage of low academic ability students to be accepted as new students. Thus, the low academic ability students can also receive a decent education. The findings of this research can also be used as a solution for schools that have admitted low academic ability students. An appropriate learning model should be implemented in the classroom to improve students' achievement. However, the potentials of Remap Coople combined with RT requires further investigation, especially to students' achievement who have low ability.

Acknowledgement

This research was supported by the Directorate of Research and Community Service – Ministry of Research, Technology, and Higher Education of the Republic of Indonesia - General Directorate of Research, Reinforcement and Development, on research funding with a letter of assignment agreement No. 047/SP2H/LT/DRPM/II/2016 and No. 151/SP2H/LT/DRPM/III/2016. Also, the authors would like to thank Nara Sari for proofreading the article.

References

Adams, R. A. (2013). *Cooperative learning effects on the classroom* (Published master's thesis, Northern Michigan University).

Adediwura, A. A., & Tayo, B. (2007). Perception of teachers' knowledge, attitude and teaching skills as a predictor of academic performance in Nigerian secondary schools. *Educational Research and Review, 2*(7), 165–171.

Adhani, A. (2014). *Pengaruh pembelajaran reciprocal teaching dan kemampuan akademik terhadap keterampilan berpikir kritis, aktivitas lisan, dan hasil belajar kognitif biologi siswa kelas XI semester genap di SMA Kabupaten Takalar* [The effect of reciprocal teaching and academic ability on critical thinking skills, oral activities and biology cognitive learning results of class XI students in the second semester of Senior High School Kabupaten Takalar (Abstract)]. Retrieved from http://library.um.ac.id/free-contents/download/pub/pub. php/65353.pdf

Akanda, A. K. M. E. A., Hoq, K. M. G., & Hasan, N. (2013). Reading habit of students in social sciences and arts: A case study of Rajshahi University. *Chinese Librarianship: an International Electronic Journal*, 35. Retrieved from http://www.iclc.us/cliej/cl35AHH.pdf

Akiri, A. A., & Ugborugbo, N. M. (2009). Teachers' effectiveness and students' performance in public secondary schools in Delta State, Nigeria. *Stud Home CommSci*, *3*(2), 107–113.

Alabekee, C. E., Samuel, A., & Osaat, S. (2015). Effect of cooperative learning strategy on students learning experience and achievements in mathematics. *International Journal of Education Learning and Development, 3*(4), 67–75.

Allington, R. L. (1984). Oral reading. In P. D. Pearson (Ed.), *Handbook of reading research* (pp. 829–864). New York, NY: Longman.

Anderson, R. C., & Pearson, P. D. (1984). *A schema-theoretic view of basic processes in reading comprehension*. New York, NY: Longman.

Antika, L. T. (2015). *Hubungan antara minat baca, keterampilan metakognitif, dan keterampilan berpikir kritis dengan hasil belajar biologi berbasis reading concept map think pair share* [Relationship between reading interest, Metacognitive skills, and critical thinking skills with learning-based biology learning reading concept map think pair share] (Unpublished master thesis). Universitas Negeri Malang, Indonesia.

Arleen, M. (2010). Sustaining students' reading comprehension. *Kappa Delta Pi*, *46*(2), 87–89.

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), 254–270.

Bolkan, S., & Goodboy, A. (2009). Transformational leadership in the classroom: Fostering student learning, student participation, and teacher credibility. *Journal of Instructional Psychology*, *36*(4), 296–306.

Brinkerhoff, J. L., & Booth, G. M. (2013). The effect of concept mapping on student achievement in an introductory non-majors biology class. *European International Journal of Science and Technology*, *2*(8), 43–72.

Brown, A. L., Palincsar, A. S., & Purcell, L. (1986). Poor readers: Teach, don't label. In U. Neisser (Ed.), *The academic performance of minority children: A new perspective* (pp. 105–143). Hillsdale, NJ: Erlbaum.

Buchs, C., Filippou, D., Pulfery, C., & Volpe, Y. (2017). Challenges for cooperative learning implementation: Reports from elementary school teachers. *Journal of Education for Teaching*, *43*(3), 296–306.

Busato, V. V., Prins, F. J., Elshout, J. J., & Hamaker, C. (2000). Intellectual ability, learning style, personality, achievement motivation and academic success of psychology students in higher education. *Personality and Individual Differences, 29*(6), 1057–1068.

Chall, J. (2000). *The academic achievement challenge: What really works in the classroom.* New York, NY: The Guilford Press.

Chamorro-Premuzic, T., & Arteche, A. (2008). Intellectual competence and academic performance: Preliminary validation of a model. *Intelligence, 36*(6), 564–573.

Chen, Q., & Liu, Y. (2017). The impact of cooperative learning on students' achievements and its changes over the past decade. *International Journal of Higher Education*, 6(2), 75–88.

Chiou, C. (2008). The effect of concept mapping on students' learning achievements and interests. *Innovations in Education and Teaching International*, *45*(4), 375–387.

Colombo, M. (2011). *Teaching English language learners: 43 strategies for successful K-8 classrooms.* Thousand Oaks, CA: SAGE Publications.

Corebima, A. D. (2005, May). *Pengukuran kemampuan Berpikir pada pembelajaran biologi* [Measuring thinking ability in biology learning]. Paper presented at Seminar Dies 41st Universitas Negeri Yogyakarta, Indonesia.

Cunningham, A. E., & Stanovich, K. E. (1998). What reading does for the mind. *American Educator/ American Federation of Teachers*, *1*(2), 137–149.

Daley, J. B. (2010). Concept maps: Practice applications in adult education and human resource development. *New Horizons in Adult Education and Human Resource Development*, *24*(2-4), 31–37.

Davies. (1997). *Introducing reading.* New York, NY: Penguin English.

Deka, U. (1993). *Factors of academic achievement: A comparative study of high and low achievers.* New Delhi: Northern Book Centre.

Diaz, A. L. (2003). Personal, family, and academic factors affecting low achievement in secondary school. *Electronic Journal of Research in Educational Psychology and Psychopedagogy*, *1*(1), 43–66.

Dinnurriya, 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* (Abstract) [The effect of biology learning model-based on reading concept map numbered heads together (Remap NHT) on reading interest, metacognitive ability, critical thinking skills, and cognitive learning results of the students of class X Senior High School Malang (Abstract)]. Retrieved from http://karyailmiah.um.ac.id/index.php/ disertasi/article/view/41789

Efendi, N. (2013). Pengaruh pembelajaran reciprocal teaching dipadukan think pair share terhadap peningkatan kemampuan metakognitif siswa SMA berkemampuan akademik berbeda di Kabupaten Sidoarjo [The effect of reciprocal teaching learning integrated with think pair share on the improvement of metacognitive of Senior High School students having different levels of academic ability in Sidoarjo District]. *Jurnal Santiaji Pendidikan, 3*(2), 85–109.

El Koumy, A. S. A. K. (2006). *The effect of the directed reading-thinking activity on EFL students' referential and inferential comprehension.* Egypt: Suez Canal University.

Erickson, E. (2008). A Reading program to narrow the achievement gap. *Reading Improvement*, *45*(4), 170–180.

Fuad, N. M., Zubaidah, S., Mahanal, S., & Suarsini, E. (2016). Improving junior high schools' critical thinking skills based on test three different models of learning. *International Journal of Instruction, 10*(1), 101–106.

Graesser, A. C., McNamara, D. S., & Louwerse, M. M. (2003). *What do readers need to learn in order to process coherence relations in narrative and expository text?* In A. P. Sweet & C. E. Snow (Eds.), *Rethinking reading comprehension* (pp. 82–98). New York, NY: Guilford Press.

Ganai, M. Y., & Maqbool, A. (2016). *A Study of self-concept, mental health and academic achievement of orphan and non-orphan adolescents.* Hamburg: Anchor Academic Publishing.

Glynn, T., Wearmouth, J., & Berryman, M. (2005). *Supporting students with literacy difficulties: A responsive approach.* Berkshire, UK: Open University Press, McGraw-Hill Education.

Guastello, E. F., Beasley, T. M., & Sinatra, R. C. (2000). Concept mapping effects on science content comprehension of low-achieving inner-city seventh graders. *Remedial and Special Education*, *21*(6), 264–356.

Gull, F., & Shehzad, S. (2015). Effects of cooperative learning on students' academic achievement. *Journal of Education and Learning, 9*(3), 246–255.

Handoko, F., Nursanti, E., Harmanto, D., & Sutriono. (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.

Hannon, B., & Daneman, M. (2001). A new tool for measuring and understanding individual differences in the component processes of reading comprehension. *Journal of Educational Psychology*, *93*(1), 103–128.

Hariyadi, S., Corebima, A. D., Zubaidah, S., & Ibrohim, S. (2018). Contribution of mind mapping, summarizing, and Questioning in the RQA learning model to genetic learning outcomes. *Journal of Turkish Science Education*, *15*(1), 80–88

Hasan, A., Zubaidah, S., & Mahanal, S. (2014). 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 [The implementation of reading concept map student teams achievement divisions learning model to improve reading interest, critical thinking skills, Metacognitive awareness and learning results of the students of class X Natural Science of Senior High Insan Cendekia Shalahudin Malang]. *Proceeding of National Conference XI Biology Education FKIP UNS: Biologi, Sains, Lingkungan, dan Pembelajarannya, 11*(1), 810–817.

Jacob, A. B., & Leafgreen, L. (2004). Remedial education and student achievement: A regression-discontinuity analysis. *Review of Economics and Statistics,* 86(1), 226–244.

Johnson, D. W., & Johnson, R. T. (1999). Making cooperative learning work. *Theory Into Practice, 38*(2), 67–73.

Kadian, A. (2016). The relation between academic achievement, executive function, intelligence, and metacognition. *The International Journal of Indian Psychology, 3*(4), 166–174.

Kagan, S. (1994). *Cooperative learning, resources for teachers*. San Juan Capistrano, CA: Kagan Cooperative Learning.

Kardeniz, A. (2015). An examination of critical reading self-efficacy perceptions among the students of the faculty of education over different variables. *Anthropologist*, *22*(2), 167–175.

Kerneza, M., & Kosir, K. (2016). Comics as a literary-didactic method and their use for reducing gender differences in reading literacy at the primary level of education. *Center for Educational Policy Studies Journal*, *6*(2), 125–149.

Kinchin, I. M., & Hay, D. B. (2000). How a qualitative approach to concept map analysis can be used to aid learning by illustrating patterns of conceptual development. *Educational Research, 42*(1), 43–57.

King, A. (1991). Effects of training in strategy questioning on children's problem-solving performance. *Journal of Education Psychology*, *83*(3), 307–317.

Knipper, K. J. (2003). Reading programs don't teach-teachers teach! *The Delta Kappa Gamma Bulletin*, *69*(2), 36–40.

Kulkarni, M. (2016). *Benefits of ICT-based learning strategies for students*. Raleigh: Lulu Publication.

Kurniawati, Z. L. (2016). P*engaruh model pembelajaran biologi berbasis reading-concept map-cooperative script (Remap-CS) dan kemampuan akademik terhadap keterampilan metakognitif, keterampilan berpikir kritis, dan hasil belajar kognitif siswa kelas X SMA negeri Kota Batu* [The influence of learning-based biology model of reading-concept map-cooperative script (Remap-CS) and academic ability to metacognitive skills, critical thinking skills, and cognitive learning outcomes of grade X students of State Senior High School Batu](Unpublished master thesis). Universitas Negeri Malang, Indonesia.

Lubliner, S. (2004). Help for struggling upper-grade elementary readers. *The Reading Teacher*, *57*(5), 430–438.

Mahakulkar, V., & Wanjari, S. 2013. Assessing reading habits of b. ed. trainee teachers. *International Journal of Education and Psychological Research (IJEPR*), *2*(4), 99–105.

Mahanal, S., Zubaidah, S., Bahri, A., & Dinnurriyya, S. M. (2016). Improving students' critical thinking skills through Remap NHT in Biology classroom. *Asia-Pacific Forum on Science Learning and Teaching*, *17*(2), 1–19.

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.

Mamu, H. D. (2014). Pengaruh strategi pembelajaran, kemampuan akademik dan interaksinya terhadap keterampilan berpikir kritis dan hasil belajar kognitif IPA biologi [The effect of learning strategies, academic ability and their interaction on critical thinking skills and cognitive learning results of science biology]. *Jurnal Pendidikan Sains, 2*(1), 1–11.

Marthaliakirana, A. D. (2014). *Pengaruh strategi pembelajaran reading, questening and answering (RQA) dan reciprocal teaching (RT) terhadap kemampuan metakognitif, pemahaman konsep dan retensi dalam pembelajaran biologi siswa SMA di Jember* [The influence of reading, questioning, and answering (RQA) and Reciprocal teaching (RT) learning strategy toward high school students' metacognitive skills, Concept understanding, and retention on biology lesson in Jember] (Unpublished master thesis). Universitas Negeri Malang, Malang Indonesia.

Marzano, R. J. (2003). *What works in schools*. Alexandria, VA: Association for Supervision and Curriculum Development.

Marzano, R. J. (2004). *Building background knowledge for academic achievement: Research on what works in schools*. Alexandria, VA: Association for Supervision and Curriculum Development.

Marzano, R. J. (2006). *Classroom assessment and grading that work*. Alexandria, VA: Association for Supervision and Curriculum Development.

McAllum, R. (2014). Reciprocal teaching: Critical reflection on practice. *Kairaranga*, *15*(1), 26–35.

McCloughlin, T. J. J., & Matthews, P. S. C. (2017). Personal constructions of biological concepts–the repertory grid approach. *Center for educational policy studies Journal, 7*(1), 93–110.

McKenna, M. C. (2002). *Help for struggling readers*: *Strategies for grades 3-8*. New York, NY: The Guilford Press.

McLeod, J., Fisher, J., & Hoover, G. (2003). *The key elements of classroom management: managing time and space, student behavior, and instructional strategies*. Alexandria, VA: Association for Supervision and Curriculum Development.

Mistianah., Corebima, A. D., & Zubaidah, S. (2015, April). *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* [The differences in metacognitive skills and learning results between the students who learned by using reading concept map GI learning model and those who learned by using reading concept map jigsaw in public Senior High Schools Malang]. Paper presented at Conference National Biology Education, Symposium on Biology Education (Symbion) in Universitas Ahmad Dahlan, Jogjakarta, Indonesia.

Mullis, I. V. S. (2012). *PIRLS 2011 international results in reading*. Boston, MA: TIMSS & PIRLS International Student Center, Lynch School of Education.

Nesbit, J, C., & Adesope, O.O. (2006). Learning with concept and knowledge maps. *A Meta-Analysis Review of Educational Research*, *76*(3), 413–448.

Newman-Ford, L., Lloyd, S., & Thomas, S. (2009). An investigation into the effects of gender, prior academic achievement, place of residence, age, and attendance on first-year undergraduate attainment. *Journal of Applied Research in Higher Education*, *1*(1), 13–28.

Niemi, D. (1999). *Assessment models for aligning standards and classroom practice*. Los Angeles, CA: UCLA Graduate School of Education and Information studies, Centre for the Study of Evaluation, & National Centre for Research on Evaluation, Standards and Students Testing.

Novak, J. D., & Canas, A. J. (2008). *The theory underlying concept maps and how to construct and use them, technical report IHMC Cmap Tools.* Pensacola, FL: Institute for Human and Machine Cognition.

Novak. J. D. (2008). *The theory underlying concept maps and how to construct them.* Pensacola, FL: Florida Institute for Human and Machine Cognition.

Novak. J. D. (2002). Meaningful learning: The essential factor for conceptual change in limited or inappropriate propositional hierarchies leading to empowerment of learners. *Science Education*, *86*(4), 548–571.

Ögeyik, M. C., & Akyay, E. (2009). Investigating reading habits and preferences of student teachers at foreign language departments. *The International Journal of Language Society and Culture, 28*, 72–79.

Ogonnaya, U. P., Okafor, G., Abonyi, O. S., & Gama, J. O. (2016). Effects of concept mapping instruction approach on students' achievement in basic science. *Journal of Education and Practice*, *7*(8), 79–84.

Owusu-Acheaw, M. (2014). *Reading habits among students and its effect on academic performance: A study of students of Koforidua Polytechnic*. Retrieved from https://digitalcommons.unl.edu/libphilprac/1130/

Özbay, M. 2006. Okuma eğitiminde çevre faktörü [Environmental factor in reading education]. *Eurasian Journal of Educational Research*, *24*, 161–170.

Ozuru, Y., Dempsey, K., & McNamara, D.S. (2009). Prior knowledge, reading skill, and text cohesion in the comprehension of science texts. *Learning and Instruction*, *19*(3), 228–242.

Padma, B. (2008). *Reciprocal teaching techniques*. Delhi: Balaji Offset.

Palincsar, A. S., & Brown, A. (1984). Reciprocal teaching of comprehension fostering and comprehension-monitoring activities. *Cognition and Instruction*, *1*(2), 117–175.

Palincsar, A. S., & Klenk, L. (1991). *Dialogues promoting reading comprehension: Teaching advanced skill to at-risk student*. San Francisco, CA: Jossey-Bass.

Pangestuti, A. A. (2014). *Penerapan model pembelajaran biologi berbasis reading concept map teams games tournaments untuk meningkatkan minat baca, kemampuan berpikir kritis, metakognitif, dan hasil belajar kognitif siswa kelas X IPA 4 SMA Laboratorium UM [*The implementation of biology learning model based on reading concept map teams games tournaments to improve reading interest, critical thinking skill, metacognition, and cognitive learning results of the students of class X natural science 4 Senior High Schools Laboratory UM (Abstract)]. Retrieved from http://mulok.library.um.ac.id/index3. php/66810.html

Pangestuti, A. A., Susilo, H., & Zubaidah, S. (June, 2014). *Penerapan model pembelajaran biologi berbasis reading – concept map –teams games tournaments untuk meningkatkan kemampuan berpikir kritis dan hasil belajar kognitif siswa kelas X IPA 4 SMA Laboratorium UM* [The implementation of biology learning model based on reading concept map teams games tournaments to improve critical thinking skill and cognitive learning results of the students of class X natural science 4 Senior High Schools Laboratory UM]. Paper presented at National Conference XI Biology, Sains, Environment, dan Education in Universitas Sebelas Maret.

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.

Parker, L. E. (1994). Working together: perceived self and collective-efficacy at the workplace. *Journal of Applied Social Psychology*, *24*(1), 43–59.

Patrick, A. O. (2011). Concept mapping as a study skill: Effects on students' achievement in biology. *International Journal of Educational Sciences*, *3*(1), 49–57.

Patterson, N. (2016). Reading: A Definition that Supports Instruction. *Colleagues, 13*(1), Article 4. Retrieved from: http://scholarworks.gvsu.edu/colleagues/vol13/iss1/4

Prasmala, E. R., Zubaidah, S., & Mahanal, S. (2014). *Penerapan model reading map group investigation (GI)untuk meningkatkan kemampuan berpikir kritis dan hasil belajar biologi siswa kelas X SMA Surya Buana Malang* [Implementation of model mind map investigation (GI) to increase critical thinking ability and learning result of student Biology of class X SMA Surya Buana Malang]. Proceedings of National Seminar XI Biology Education UNS, *11*(1), 835–839.

Prayitno, A. B., Corebima. D., Susilo. H., Zubaidah. S., & 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.

Parveen, Q. (2012). Effect of cooperative learning on achievement of students in general science at secondary level. *International Education Studies, 5*(2), 54–58.

Prihatiningsih, Zubaidah, S., & Kusairi, S. (2016). *Kemampuan berpikir kritis siswa SMP pada materi* *klasifikasi makhluk hidup* [Critical thinking ability of Junior High School students on material classification of living creatures]. National Seminar Proceeding. Pendidikan IPA Pascasarjana UM, Universitas Negeri Malang.

Ramadhan, F. (2017). *Pengaruh model pembelajaran biologi berbasis reading concept map student teams achievement division (remap STAD) dan kemampuan akademik terhadap keterampilan berpikir kritis, keterampilan berpikir kreatif, dan hasil belajar kognitif siswa kelas X SMA Kota Batu* [The influence of learning model biology based reading- concept map student teams achievement division (Remap-STAD) and academic ability to critical thinking skills, creative thinking skills, and cognitive learning outcomes of grade X students of SMA Batu City](Unpublished master thesis). Universitas Negeri Malang, Indonesia.

Rosyida, F. (2016). *Pengaruh pembelajaran biologi berbasis reading concept map-timed pair share dan kemampuan akademik berbeda terhadap keterampilan metakognitif, keterampilan berpikir kritis, dan hasil belajar kognitif siswa kelas X MIA SMA Negeri Batu* [The influence of learning based biology reading concept map-timed pair share and academic ability different to metacognitive skills, critical thinking skills, and cognitive learning outcomes of grade X students of SMA Negeri Batu] (Unpublished master thesis). Universitas Negeri Malang, Indonesia.

Santiago, H. C. (2011). Visual mapping to enhance learning and critical thinking skills. *Optometric Education, 36*(3), 125–139.

Setiawan, D., Zubaidah, S., & Mahanal, S. (2015). *Minat baca dan keterampilan metakognitif pada pembelajaran biologi berbasis reading concept map think pair share* [Reading interests and metacognitive skills on learning-based biology reading concept map think pair share]. Paper presented at the national seminar on biological education, a symposium on Biology Education (Symbion), Universitas Ahmad Dahlan Jogjakarta.

Shamshuddin, S. (2007). *Values and academic achievement.* New Delhi: Discovery Publishing House.

Sholihah, M. (2016). *Pengaruh model pembelajaran biologi berbasis reading concept map reciprocal teaching (Remap RT) dan kemampuan akademik berbeda terhadap keterampilan metakognitif, keterampilan berpikir kritis, dan hasil belajar kognitif siswa kelas X SMA Negeri Kota Batu* [Influence of learning-based biology model reading concept map reciprocal teaching (Remap RT) and different academic ability to metacognitive skills, critical thinking skills, and cognitive learning outcomes of grade X students of State Senior High School Batu] (Unpublished master thesis). Universitas Negeri Malang, Malang Indonesia.

Siegel, C. (2005). Implementing a research based model of cooperative learning. *The Journal of Educational Research, 98*(6), 1–15.

Siska, F., Ardi., & Risdawati, R. (2016). *Pengembangan lembar kejra siswa bernuansa problem based learning pada materi protista untuk siswa SMA* [Development of student worksheet nuanced problem based learning on protista material for Senior High School students]. Padang: Sekolah Tinggi Keguruan dan Ilmu Pendidikan PGRI Sumatera Barat.

Slavin, R. E. (2005). *Cooperative learning.* London, UK: Allyn and Bacon.

Smajdek, A., & Selan, J. (2016). The impact of active visualisation of high school students on the ability to memorise verbal definitions. *Center for Educational Policy Studies Journal*, *6*(4), 163–185.

Springer, L., Stanne, M. E., & Donovan, S. S. (1999). Effects of small-group learning on undergraduates in science, mathematics, engineering, and technology: A meta-analysis. *Review of Educational Research, 69*(1), 21–51.

Sukardi, D, A., Susilo, H., & Zubaidah, S. (2015). Pengaruh pembelajaran reciprocal teaching berbantuan peta pikiran (mind map) terhadap kemampuan metakognitif dan hasil belajar siswa SMA [The influence of reciprocal teaching-aided learning mind map (mind map) on metacognitive ability and high school students outcomes]. *Jurnal Pendidikan Sains*, *3*(2), 81–89.

Suparoh, S. (2010). *Analisis kesulitan belajar siswa dalam memahami konsep biologi pada konsep monera* [Analysis of students' learning difficulties in understanding the concept of biology on the concept of monera]. Jakarta: Universitas Islam Negeri Syarif Hidayatullah.

Suratno. (2009). *Pengaruh strategi kooperatif jigsaw dan reciprocal teaching terhadap keterampilan metakognisi dan hasil belajar biologi siswa sma berkemampuan atas dan bawah di Jember [*The effect of cooperative strategy jigsaw and reciprocal teaching on metacognitive skills and biology learning results of senior high school students having high and low academic ability in Jember] (Unpublished doctoral dissertation). Universitas Negeri Malang, Indonesia.

Tran, D. V. (2014). The effects of cooperative learning on the academic achievement and knowledge retention. *International Journal of Higher Education*, *3*(2), 131–140.

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* [The Influence of Learning-Based Biology Model of Reading-Concept Map-Think Pair Share (Remap-TPS) and Different Academic Ability to Critical Thinking Skills, Creative Thinking Skills, and Cognitive Learning Outcomes of Stone X Year Students] (Unpublished master thesis). Universitas Negeri Malang, Malang Indonesia.

Tendrita, M., Mahanal, S., & Zubaidah, S. (2017). Pembelajaran *reading-concept-map think pair share (Remap TPS)* dapat meningkatkan hasil belajar kognitif [Reading-concept-map learning think pair share (Remap TPS) can improve cognitive learning outcomes]. *Jurnal Pendidikan: Teori, Penelitian, dan Pengembangan, 2*(6), 763–767.

Vanides, J., Yin, Y., Tomita, M., & Ruiz-Primo, M. A. (2005). Using concept maps in the science classroom. *National Science Teachers Association (NSTA*), *28*(8), 27–31.

Veas, A., Gilar, R., & Minano, P. (2016). The influence of gender, intellectual ability, academic, self-concept, self-regulation, learning strategies, popularity and parent involvement in early adolescence. *International Journal of Information and Education Technology, 6*(8), 591–597.

Veenman, M. V. J., & Beishuizen, J. J. (2004). Intellectual and metacognitive skills of novices while studying texts under conditions of text difficulty and time constraint. *Learning and Instruction*, 14(6), 621–640.

Veenman, M. V. J., & Spaans, M. A. (2005). The relation between intellectual and metacognitive skills: Age and task differences. *Learning and Individual Differences*, *15*(2), 159–176.

Vermon, P. A. (1990). The use of biological measures to estimate behavior intelligence. *Educational Psychologist*, *25*(3–4), 293–304.

Vermunt, J. D., & Verloop, N. (1999). Congruence and friction between learning and teaching. *Learning and Instruction*, *9*, 257–280.

Wanjari, S., & Mahakulkar, V. (2011). Assessing reading habits of trainee teachers. *Indian Streams Research Journal, 11*(1), 76–81.

Warouw, Z. W. M. (2009). *Pengaruh pembelajaran metakognitif dalam strategi cooperative script dan reciprocal teaching pada kemampuan akademik berbeda terhadap kemampuan dan keterampilan metakognitif, berpikir kritis, hasil belajar biologi siswa, serta retensinya di SMP Negeri Manado* [The influence of metacognitive learning in cooperative script and reciprocal teaching strategies on the different academic ability to metacognitive skills and skills, critical thinking, student biology learning outcomes, and retention in SMP Negeri Manado] (Unpublished master thesis). Universitas Negeri Malang, Malang Indonesia.

Widayati. (2015). *Pengaruh strategi pembelajaran reading questioning and answering dipadu dengan think pair share dan kemampuan akademik terhadap kemampuan berpikir kritis dan hasil belajar kognitif pada pembelajaran biologi kelas VIII SMP di Kabupaten Blitar* (Abstract) [The effect of reading questioning and answering learning strategies combined with think pair share and academic ability on the critical thinking skills and cognitive learning results in biology learning of class VIII Junior High School students in Blitar (Abstract)]. Retrieved from http:// karya-ilmiah.um.ac.id/index.php/disertasi/article/view/42637

Yusnaeni, Corebima, A. D., Susilo, H., & Zubaidah, S. (2017). Creative thinking of low academic student undergoing search solve create and share learning integrated with metacognitive strategy. *International Journal of Instruction*, *10*(2), 245–262.

Zubaidah, S. (2014, June). *Pemberdayaan keterampilan penemuan dalam scientific approach melalui pembelajaran berbasis remap coople* [Empowering the discovery skills in scientific approach by using remap coople based learning]. Paper presented at National Conference XI Biology, Sains, Environment, dan Education in Universitas Sebelas Maret, Solo.

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.

Zubaidah, S., Fuad, N. M., Mahanal, S., Suarsini, E. (2017). Improving creative thinking skills of students through differentiated science inquiry integrated with mind map. *Journal of Turkish Science Education*, *14*(4), 77–91.

Biographical note

Siti Zubaidah, PhD, is a full professor in Genetics in Biology Education, Faculty of Mathematics and Natural Sciences, Universitas Negeri Malang, Indonesia. Her research is related to soybean breeding. However, her attention to the education field is quite significant, and with the assistance of her students, she has done much research on models and learning strategies that encourage students' thinking skills.

Susriyati Mahanal, PhD, is a full professor in Biology Education, Faculty of Mathematics and Natural Sciences, Universitas Negeri Malang, Indonesia. Her research in the field of biology education and learning is related to the development of teaching and assessment materials, classroom action research, and the development of active learning strategies that encourage students' thinking skills.

Mar'atus Sholihah has a Master's of Biological Education, Faculty of Mathematics and Natural Sciences, Universitas Negeri Malang, Indonesia. Currently, she works as a lecturer in biology education at the Faculty of Education at Universitas Islam Balitar, Indonesia. Her research in the field of biology education includes experimental learning models, classroom action research, analysis and measurement of learning motivation, critical thinking skills, metacognitive skills, and students' learning outcomes.

Fatia Rosyida has a Master's of Biological Education, Faculty of Mathematics and Natural Sciences, Universitas Negeri Malang, Indonesia. Currently, she works as a teacher at Tuban Public High School 4, Indonesia. Research that has been carried out includes experimental learning models by measuring metacognitive skills, critical thinking skills, learning motivation, cognitive learning outcomes, and students' retention.

Zenia Lutfi Kurniawati is the Master of Biological Education from Biology Education, Faculty of Mathematics and Natural Sciences, Universitas Negeri Malang, Indonesia. Currently, she works as a lecturer in Biology Education at the Mulawarman University Teacher Training and Education Faculty, Indonesia. Research that has been conducted includes the development of learning media, experimental learning models, classroom action research, lesson study, empowerment of students' thinking skills and student literacy. Another activity carried out was an effort to increase student awareness of the surrounding natural environment.