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Improving Students' Critical Thinking in Biology Learning through Reading, Concept Mapping-Team Quiz

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ABSTRACT

Abstract: This study aimed to examine an increase in students' critical thinking in biology following the implementation of the Reading Concept Mapping-Team Quiz (Remap-TQ). The study employed a quasi-experimental pretest-posttest non-equivalent control group design. The research population contained all eleventh graders from seven science classes at SMAN 2 Tanggul Jember, East Java, and the total number of respondents was 105 students. This study's critical thinking indicators include applying, evaluating, using data to develop critical insight, analysing, and synthesising. The analysis showed that the Remap-TQ students achieved better than the TQ and conventional students in terms of critical thinking, indicated by their posttest mean score of 84.29. The findings from this study suggest that Remap-TQ can be used as an alternative learning strategy to improve students' critical thinking in biology.

Biology is an important subject that can help students understand nature (Kisoglu, 2018; Shen, Li, & Lee, 2018). Biology learning emphasizes student interactions and experiences to understand various things that happen in life (Wegner & Schmiedebach, 2020). The material discussed in biology learning can generally train students' thinking skills to understand the material more deeply, for example, the material on systems in the body because students are required to be able to understand the organs, functions, and processes that occur within them (Santosa & Sepriyani, 2020). In reality, it is not easy for students to understand system material on the body because it covers a wide range and is considered rote material and material concepts challenging to learn (Prasmala & Tanggu, 2020). Biology material related to body systems is essential for students to understand because it teaches students to appreciate the subject and see how the subject or process works and its application in everyday life (Shuaibu & Ishak, 2020). Biology is one of the subjects that contributes to empowering 21st century skills, and these skills can be carried out through learning (Zubaidah, 2016).

The 21st century skills students need to possess include critical thinking, creativity, problem-solving, collaboration, communication, and innovation (Trilling & Fadel, 2009). Critical thinking is an essential skill because it is a crucial component of science education that aims to prepare students to think and be responsible for everything increasingly influenced by science and technology (Vieira & Vieira, 2014). According to Facione (2015), critical thinking skills aim to prove and interpret meaningful things and solve problems. Students need to develop critical thinking skills because it is a way to increase their understanding of knowledge and content in learning (Johnson, 2008).

Steps to train critical thinking can be done by asking questions that require high-level thinking. It encourages students to examine concepts further to obtain a deeper understanding (Nappi, 2017). Empowerment of students' critical thinking, especially in biology learning, according to Bissell and Lemons (2006), can be done by asking questions related to content that encourages thinking processes and using an assessment rubric to determine indicators of critical thinking from student answers. The research results of Agustine, Nizkon, and Nawawi (2020) show that 59.26% of students still have low critical thinking skills in high school biology learning. It is because students need help explaining and giving logical reasons for the questions given. The results of Onsee and Nuangchalerm's research (2019) show that students still have an average score of less than 70% in critical thinking skills.

The results of an interview with a biology teacher at SMAN 2 Tanggul in August 2021 showed that students' critical thinking skills in learning biology are sufficient. It is evidenced by the results of the average initial test score of students' critical thinking skills of 52.92% in the good category. It shows that students' critical thinking skills need to be maximized. The causative factor (according to the results of interviews and needs analysis questionnaires) is that students rarely read the material or make concept maps before learning. In addition, students are still embarrassed to express things that have yet to be understood, lack group cooperation, and are less active in learning activities. Students still rely on material sources only from the teacher, and the teaching materials need to contain activities/questions that train critical thinking skills. Thus, students critical thinking skills still need to be improved.

The improvement of students' critical thinking skills, according to the research results of Utami, Ramalis, and Saepuzaman (2016), is influenced by the selection of learning models that have an impact on student learning processes. Fitriani, Zubaidah, Susilo, and Muhdhar (2020) also said that the learning model influenced students' critical thinking skills in learning biology. Learning models that can be used to improve student's critical thinking skills in biology learning include Problem-Based Learning/PBL (Puspita & Aloysius, 2019); Guided Inquiry, (Makmur, Susilo, & Indriwati, 2019), Team Quiz (Astra, Susanti, & Wulandari, 2021); Remap TmPS (Zubaidah et al., 2018); and Remap GI and Remap Jigsaw (Zubaidah, Corebima, Mahanal, & Mistianah, 2018). The PBL application has a weakness, for 28% of students still have low critical thinking skills. Meanwhile, the weakness in applying Guided Inquiry, Team Quiz, Remap TmPS, Remap GI, and Remap Jigsaw is that the organization and implementation of learning time still need to be improved to improve students' critical thinking. The results of interviews with biology teachers at SMAN 2 Tanggul in August 2021, Team Quiz (TQ), Remap TmPS, Remap GI and Remap Jigsaw have never been applied in biology learning. Therefore, one learning model that is expected to improve students' critical thinking is Reading Concept Mapping-Team Quiz (Remap-TQ). Remap-TQ refers to the Remap-Coople learning model developed by (Zubaidah, 2014) by combining reading activities and compiling concept maps (concept mapping) before learning. Then learning is carried out in cooperative learning classes (cooperative learning) using Team Quiz.

Team Quiz is a cooperative learning model and includes active learning, which can increase student responsibility for something learned (Silberman, 2006). The application of Quiz Teams in learning can help build learning communities, improve life skills, increase knowledge, and improve learning outcomes (Ludwig, 2021). The Quiz Team learning model has several steps: selecting learning topics, forming groups, delivering learning formats and learning materials, group quizzes, and providing conclusions (Suprijono, 2009). Team-based learning can train students to learn independently and be actively involved in groups (Girirajan, Joseph, Prasad, & Chakradhar, 2020). Group quiz activities in the Team Quiz learning model invite students to create and answer questions. According to Nappi (2017), this activity can train students' critical thinking skills. Previous research by Hasugian and Aryeni (2017) proved that the application of the Quiz Team learning model was effectively used in high school biology learning. Using the Quiz Team learning model based on research conducted by Haya, Yohanita, Iwan, and Ruslan (2018) can foster student enthusiasm to compete and be active in learning. In addition, it also encourages students' thinking memory so that biology material considered rote becomes easier to understand.

The application of the Quiz Team learning model has drawbacks, including only students who are considered intelligent in groups can answer questions during quizzes. Besides, the activities must be fast to shorten discussion opportunities (Sakdiah, 2021). Therefore, additional activities such as reading and making concept maps are needed. According to Wang (2012) and Xu and Pang (2020), this activity can help students gather and expand their knowledge. The provision of knowledge previously obtained is expected to assist students in making/answering questions and launching discussion activities. Thus the Quiz Team (TQ) can be combined with Reading-Concept mapping (Remap) activities which can be carried out before learning so that students are better prepared when learning in class takes place (Zubaidah, Mahanal, Sholihah, Rosyida, & Kurniawati, 2020). The results of this combination become the Reading Concept Mapping-Team Quiz (Remap-TQ) learning model.

The first activity in Remap-TQ is reading. Biology has a broad and complex range of material, so students need to read it first to make it easier to understand the content or information of the material being studied. According to Rintaningrum (2019), reading activities include an effective way of obtaining information and knowledge. Reading has significant benefits besides getting references. It also trains self-development and confidence, helps solve problems, and increases concentration power. Reading activities can also help develop students' thinking skills if done in a structured manner (Kohzadi, Azizmohammadi, & Samadi, 2014). The next activity after reading is concept mapping. The scope of biology material is extensive, complex, and considered to require memorization. Hence, students need to make concept maps so that it is easy to understand the essential concepts of the material and easy to remember for a long time. Making concept maps in biology learning can train students to think at a higher level (Lalor & Rainford, 2014). Making concept maps helps students learn meaningfully by visualizing scientific concepts from learning content so that the material is easier to remember for a long time (Dhull & Verma, 2020). According to Machado and Carvalho (2020), this activity helps develop students' critical thinking, integrating theory and practice, obtaining meaningful learning, and encouraging collaboration. The activity in Remap-TQ after making a concept map is conducting classroom learning using the Team Quiz model. Thus, the Remap-TQ Learning model, which refers to Remap-Coople, is expected to be a solution to improve student's critical thinking skills.

Several previous studies have proven that Remap Coople has the potential to improve student's critical thinking in biology lessons, including Remap CS (Kurniawati, Zubaidah, & Mahanal, 2016), Remap TmPS (Rosyida, Zubaidah, & Mahanal, 2016), Remap RT (Sholihah, Zubaidah, & Mahanal, 2016), Remap GI and Remap Jigsaw (Zubaidah et al., 2018). However, the potential of Remap-TQ to improve students' critical thinking in biology learning still needs to be discovered. Therefore, this study aimed to determine the increase in students' critical thinking in biology learning through Reading Concept Mapping-Team Quiz.

METHOD

This type of research is a quasi-experiment. The research design used a pretest-posttest non-equivalent control group design. The research was conducted in October-December 2021, the odd semester of the 2021/2022 academic year, at Tanggul 2 Public High School, Jember Regency, East Java, Indonesia. The population consisted of all students of class XI MIPA SMAN 2 Tanggul consisting of seven classes, and then a class equivalence test was carried out. The results of the equivalence test showed that the seven classes had the same criteria (equivalent), and then a random selection of research classes was carried out. The selected class consisted of three classes, totalling 105 students. The three classes include XI MIPA 3 (experimental class, taught by Reading Concept Mapping-Team Quiz, N = 35 students); XI MIPA 4 (positive control class, taught with Team Quiz, N = 36 students); XI MIPA 1 (negative control, taught by conventional learning models, N = 34 students).

The instrument for measuring critical thinking skills is a question in the form of a description equipped with a scoring rubric, according to Greenstein (2012), which includes indicators of the ability to apply, evaluate, and uses data to develop critical insight, analyze, and synthesize. This instrument has previously been tested so that it shows valid results because the value of r count (0.665) > r table (0.294), and the results are reliable because Cronbach's alpha value is 0.891. This question is then used in the pretest and posttest. The treatment instruments include a syllabus, RPP (Learning Implementation Plan), and LKPD (Student Activity Sheet).

The research was conducted in seven meetings on the material of the circulatory system and digestive system. The pretest was carried out before the treatment, while the posttest was carried out after the treatment. The observer observes the continuity of the learning process, including teacher and student activities, to assess the implementation of the learning model syntax. The syntax of the Remap-TQ learning model can be seen in figure 1.

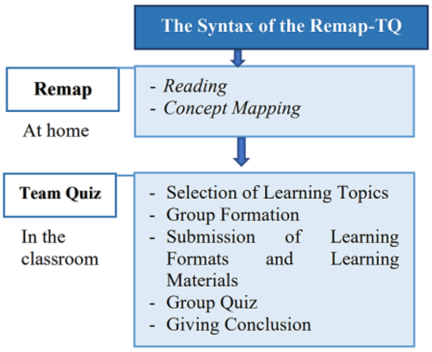

Figure 1. Remap-TQ Learning Model Syntax

The increase in critical thinking is known from the percentage of students' pretest and posttest scores on each indicator of critical thinking. The results of the percentage scores are then categorized based on the level of mastery of students' critical thinking according to Aminudin, Rusdiana, Samsudin, Hasanah, and Maknun (2019), which can be seen in table 1.

Table 1. Level of Students' Critical Thinking

Range Value	Critical Thinking Category
$81 \leq x \leq 100$	Excellent
$61 \leq x \leq 80$	Good
$41 \leq x \leq 60$	Enough
$21 \leq x \leq 40$	Less
≤ 20	Very Less

Source: Aminudin et al., (2019)

RESULTS

The pretest and posttest percentage scores of students' critical thinking skills were calculated for each treatment and for each critical thinking indicator. The results of these calculations are then classified based on the level of mastery of students' critical thinking to determine the category of increasing students' critical thinking from the results of the pretest to posttest scores. Data on students' critical thinking skills test results can be seen in table 2.

Table 2. Student Critical Thinking Skills Test Results

Category	Experiment Class (*Remap-TQ*)		Control Class (+) (*TQ*)		Control Class (-) (conversional)	
	Percentage (%)					
	Pretest	***Posttest***	***Pretest***	***Posttest***	***Pretest***	***Posttest***
Excellent	11,43%	65,71%	0	25,00%	0	14,71%
Good	31,43%	31,43%	19,44%	50,00%	14,71%	32,35%
Enough	48,57%	2,86%	63,89%	25,00%	82,35%	50,00%
Less	8,57%	0	16,67%	0	2,94%	2,94%
Very Less	0	0	0	0	0	0
Average Value	60,14	84,29	54,44	72,92	56,76	65,15

Based on table 2, the test results show that the percentage scores and categories of students' critical thinking skills in the posttest are higher than in the pretest. The results showed that out of 35 students, 65.71% of students taught with the Remap-TQ model had an excellent critical thinking category, 31.43% good, and 2.86% enough. Of students taught with the TQ model, out of 36 students, as many as 25% have excellent critical thinking categories, 50% are good, and 25% are sufficient. For students taught through conventional learning, out of a total of 34 students, 14.71% had critical thinking skills in the excellent category, 32.35% good, 50% sufficient, and 2.94% less. Overall, students taught using the Remap-TQ learning model have a more significant increase in critical thinking. It is evidenced by the posttest mean score of students' critical thinking taught with the Remap-TQ model, which was higher, namely 84.29, compared to the TQ model of 72.92 and conventional learning of 65.15.

The increase in the percentage of critical thinking indicators can be seen in more detail in figure 2 regarding the increase in the percentage in the experimental class (Remap-TQ), Figure 3 regarding the increase in the percentage in the positive control class (TQ), and figure 4 regarding the percentage increase in the negative control class (conventional).

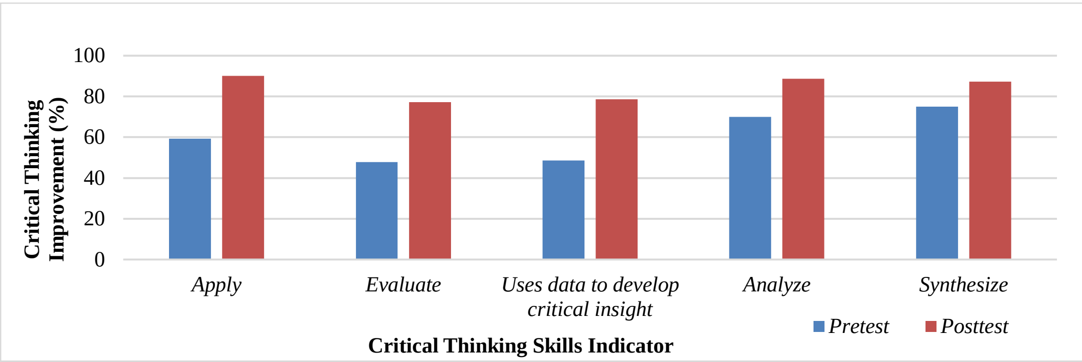

Figure 2. Percentage of Increase in Students' Critical Thinking Indicators in the Experimental Class (Remap-TQ)

Figure 2 shows an increase in each indicator of critical thinking skills in the experimental class from the pretest to the posttest. It is evidenced by the difference in the percentage increase from pretest to posttest, including the ability to apply has a difference of 30.71%, evaluate is 29.28%, using data to develop critical insight is 30%, analyze is 18.57%, and synthesize by 12.14%.

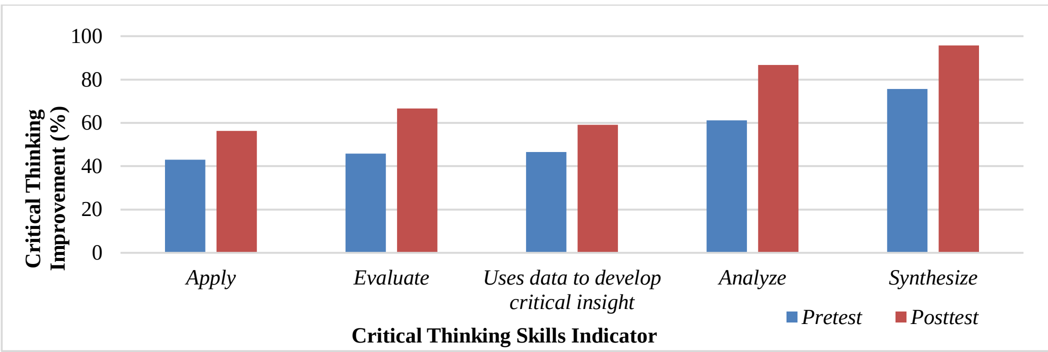

Figure 3. Percentage of Increase in Students' Critical Thinking Indicators in the Positive Control (TQ) Class

Figure 3 shows an increase from the pretest to the posttest in the positive control class, but the increase was lower than in the experimental class. It is evidenced by the difference in the percentage increase from pretest to posttest, including the ability to apply has a difference of 13.19%, evaluate is 20.84%, using data to develop critical insight is 12.5%, analyze is 25.7%, and synthesize by 20.14%. Figure 4 shows that the increase from the pretest to the posttest in the negative control class is lower than in the experimental and positive control classes. It is evidenced by the difference in the percentage increase in each indicator of critical thinking, including the ability to apply by 22.06%, evaluate by 2.21%, uses data to develop critical insight by 5.14%, analyze by 11.03%, and synthesize by 1.47%.

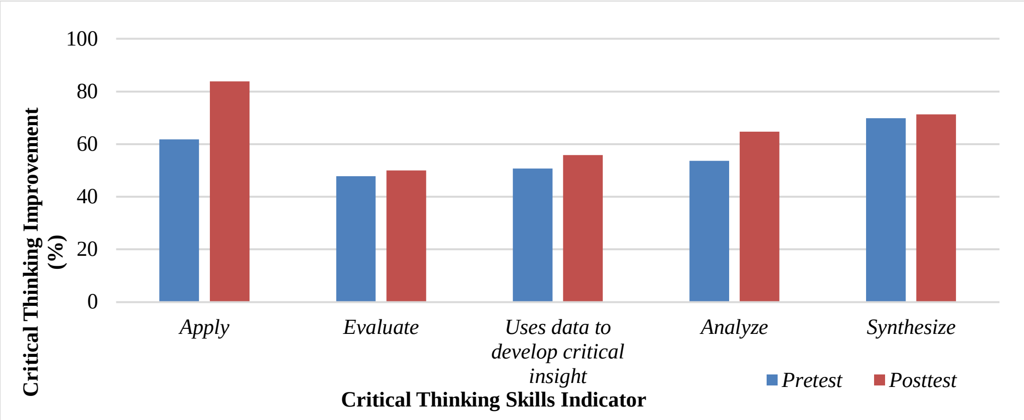

Figure 4. Percentage of Increase in Students' Critical Thinking Indicators in Negative Control Class (Conventional)

Figure 2, Figure 3, and Figure 4 show that, overall, the percentage of students' critical thinking indicators in the experimental class (Remap-TQ) has a higher increase compared to the positive control (TQ) and negative control (conventional) classes. It proves that the Remap-TQ learning model can increase students' critical thinking in biology learning.

DISCUSSIONS

Increasing students' critical thinking is influenced by the learning model applied by the teacher in learning. It is evidenced by the difference in percentage values and categories of students' critical thinking achievement levels resulting in the three treatments applied in biology learning (Remap-TQ, TQ, and conventional). Students taught with the Remap-TQ model have higher posttest percentage scores and categories of achievement levels of critical thinking than those taught with the TQ model or conventional learning. Thus, it is proven that applying the Reading Concept Mapping-Team Quiz (Remap-TQ) learning model can improve high school students critical thinking in biology learning. It is in line with the results of research conducted by Kurniawati et al. (2016); Rosyida et al. (2016); Shalihah et al. (2016); and Zubaidah et al. (2018), which states that students' critical thinking can be improved through the Coople Remap learning model.

Increasing students' critical thinking is influenced by the student learning process supported by the learning model applied by the teacher. The three learning models that have been applied provide different improvements in critical thinking. The steps of the Remap-TQ learning model in the experimental class, which includes reading activities, making concept maps (concept mapping), and Team-Quiz, can increase critical thinking. It is because, in the first stage of Remap-TQ, students carry out reading activities before learning. Reading activities help students to have the provision knowledge, which is the basis for critical thinking.

So that students can make concept maps well according to their understanding. Besides that, students can also answer and explain more deeply during group question-and-answer activities and questions contained in LKPD and during discussions during learning. It is in line with the statement, according to (Mahanal, Zubaidah, Sumiati, Sari, and Ismirawati (2019), that reading activities can support increased students' critical thinking.

In contrast to students taught using the TQ model (in a positive control class) or with conventional learning (in the negative control class), the increase was still lower than the Remap-TQ. It was seen when students did not actively participate in giving opinions during group discussion activities. It was evidenced by the percentage value of student activity in the positive control class of 70% and the positive control class negative control of 65%, which means that both are lower than the percentage of students' activeness in the experimental class of 90%. Students are also less able to provide deeper explanations when there are questions during question-and-answer activities and working on LKPD. The average value of students' LKPD work in the control class (+) is 77, control class (-) is 74, meaning both classes in the control group had a mean value less than the experimental class of 81. This problem was caused by the absence of reading activities in the control class, so students needed to gain important knowledge to use as a basis for critical thinking.

In the next Remap-TQ stage, students compile concept maps to strengthen the results of reading activities. The preparation of concept maps was carried out by students who were taught using Remap-TQ in the experimental class. Students who have read well will be seen by their ability to make concept maps. Students make different concept maps at each learning meeting according to the topic of the material being studied. An example of a concept map made by students can be seen in Figure 5 regarding the circulatory system material (blood circulation in humans). Figure 5 shows that students carried out three main processes to construct a concept map. In the first process, students see the consistency of each sequence of concepts from a higher order to a lower order, which requires students' accuracy to adjust the concept links horizontally and vertically using straight line marks. In the linear position of the concept map, students use the second process to identify the most common concepts and write them at the very top of the circulatory system sub-material. Students then re-identify more specific concepts related to general concepts, which are connected based on the classification in the sub-topics section. Students divide the central concept into three main sub-sections: the function of the circulatory system, the constituent components of blood, and the mechanism of blood clotting. The preparation of the concept map is continued by reviewing how to classify each derivative from the three main sub-sections, which cover various functions of the circulatory system, types of blood components and their shapes, as well as the occurrence of the blood clotting process. In the last process, students connect general and specific concepts using lines and shapes that are unique/different for each concept. Students can generally represent their ideas and knowledge by making key concepts. Then connecting between concepts using lines and making different shapes and colours to distinguish between concepts on each topic and sub-topic so that they can be easily read, understood, and remembered for a long time.

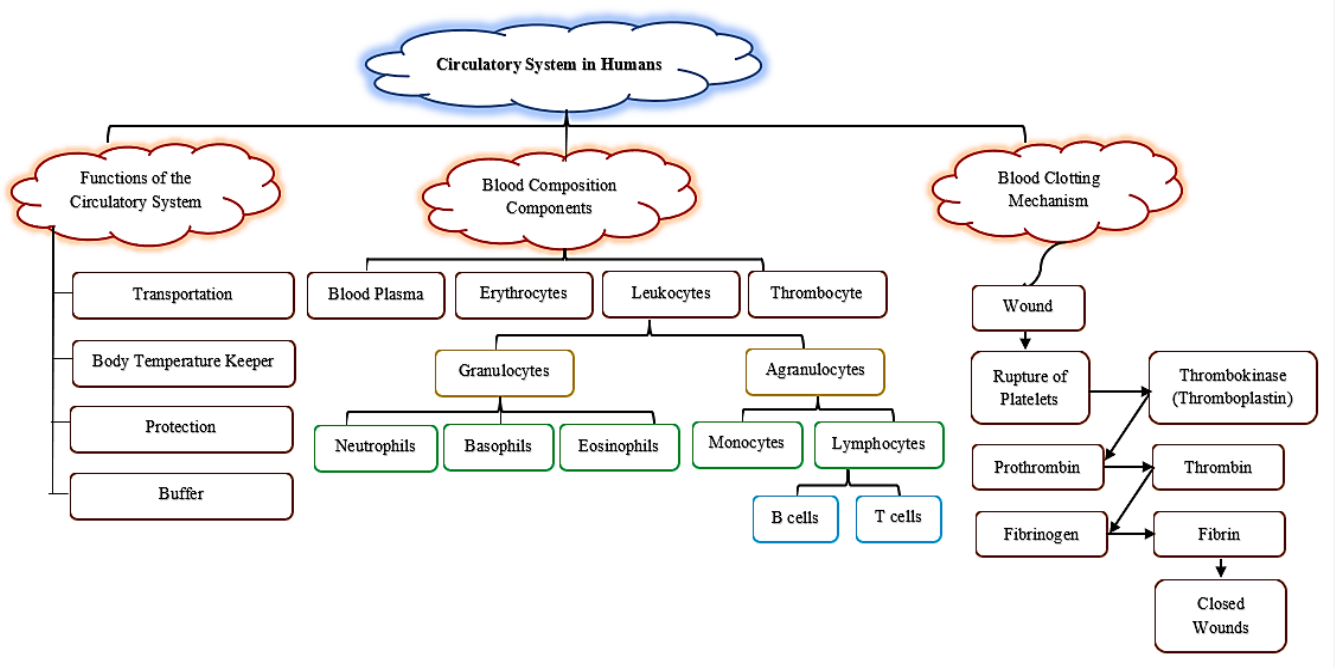

Figure 5. Circulatory System Material Concept

Concept mapping can train students' critical thinking. It enables students to make key concepts, link between concepts properly, and summarize the studied material. So, biology material considered too broad, memorized a lot, and complex can be easily understood by students and remembered for a long time. Students who have made concept maps are seen to be active in providing feedback in learning activities. Besides that, they are also fluent in giving opinions in group discussion activities and can answer questions that arise during learning. According to Canas, Reiska, and Mollits (2017) and Tseng (2019), it is supported by statements that concept mapping activities can develop critical thinking because students can identify main ideas, design concepts and summarize the information obtained. In contrast to students who were in the positive and negative control classes. They did not get concept mapping activities, so during learning activities, students were less active in providing feedback because they needed to understand biology material with a broad and complex scope.

In the next stage, students learn in class using Team Quiz (TQ), both in the experimental and positive control classes, which has a different effect on increasing students' critical thinking. Applying the TQ learning model can help students learn to make questions and answer questions that involve critical thinking skills. Students in the experimental class had a more significant increase in critical thinking than in the positive control class. It is because students in the experimental class received additional activities in the form of REMAP. In contrast, there were no REMAP activities in the positive control class, so they only used the TQ learning model. Students who were taught only with TQ seemed less able to understand the material, so during group quiz activities, students needed help making questions and giving answers. According to Sakdiah (2021), the application of TQ has areas for improvement, including only students who are considered competent who can answer questions during quizzes. Besides that, the activities are also required to be fast so that the opportunity for discussion is short. Therefore, an additional activity in the form of REMAP is a solution to overcoming the weaknesses of TQ. Remap activities help students provide knowledge and concepts related to learning materials. When learning in class using TQ, students find it easier to understand the material and answer questions even though discussion time is limited. In contrast to students taught by conventional learning, they tend to be passive when asked to ask or answer questions that arise. It is because learning places less emphasis on student activities, resulting in an increase in students' critical thinking, which is lower than that of students in other classes. The results of research by Nuryanti, Zubaidah, and Diantoro (2018), also show that the application of learning models, which teachers still dominate, needs to train students' critical thinking skills.

Educators need to develop critical thinking skills for high school students, especially in learning biology. Biology material has a broad and complex scope. It requires much memorization, so choosing a suitable learning model is an educator's strategy to make it easier for students to understand the learning material. The application of the Remap-TQ learning model needs fixing, especially when using Team Quiz for classroom learning. This obstacle is that some students still show a lengthy response to asking questions during group quiz activities because they wait for students to give questions to students in other groups. So group quiz activities become hampered and require more extended than the allotted time. Therefore, to overcome these obstacles, educators need to pay attention to time and, if possible, add time to group quiz activities by reducing time allocation in other activities. So that group quiz activities and student learning processes become optimal, and the learning material obtained becomes more meaningful, not just a rote lesson.

CONCLUSIONS

The Reading Concept Mapping-Team Quiz (Remap-TQ) learning model can improve students' critical thinking in biology learning. The increase in students' critical thinking can be seen from the difference in the posttest mean scores of students who are taught with higher Remap-TQ, which is 84.29, compared to the TQ model of 72.92, and conventional learning of 65.15. Thus, teachers can use Remap-TQ as an alternative learning model to train students' critical thinking in biology learning. For further research, educators should pay more attention to time allocation in implementing learning models so that the implementation of learning becomes more optimal.

REFERENCES

Agustine, J., Sulton, & Nawawi, S. (2020). Analisis Keterampilan berpikir Kritis Peserta Didik SMA Kelas X IPA pada Materi Virus. *Indonesian Journal of Biology Education*, *3*(1), 7–11.

Aminudin, A. H., Rusdiana, D., Samsudin, A., Hasanah, L., & Maknun, J. (2019). Measuring Critical Thinking Skills of 11th Grade Students on Temperature and Heat. *Journal of Physics: Conference Series*, *1280*, 1–5. https://doi.org/10.1088/1742-6596/1280/5/052062

Astra, I. M., Susanti, D., & Wulandari. (2021). The Effects of Active Learning Model Team Quiz Type Assisted by Animation Video on Critical Thinking Ability of High School Students. *AIP Conference Proceedings*, *2320*, 1–5. https://doi.org/https://doi.org/10.1063/5.0037590

Bissell, A. N., & Lemons, P. P. (2006). A New Method for Assessing Critical Thinking in the Classroom. *BioScience*, *56*(1), 66–72.

Canas, A. J., Reiska, P., & Mollits, A. (2017). Developing Higher-Order Thinking Skills with Concept Mapping: A Case of Pedagogic Frailty. *Knowledge Management and E-Learning*, *9*(3), 348–365. https://doi.org/10.34105/j.kmel.2017.09.021

Dhull, P., & Verma, G. (2020). Use of Concept Mapping for Teaching Science. *The International Journal of Analytical and Experimental Modal Analysis*, *12*(3), 2481–2491.

Facione, P. A. (2015). *Critical Thinking : What It Is and Why It Counts*. Hermosa Beach CA: Measured Reason LLC.

Fitriani, A., Zubaidah, S., Susilo, H., & Muhdhar, M. H. I. Al. (2020). PBLPOE: A Learning Model to Enhance Students' Critical Thinking Skills and Scientific Attitudes. *International Journal of Instruction*, *13*(2), 89–106. https://doi.org/10.29333/iji.2020.1327a

Girirajan, B., Joseph, L. M. I. L., Prasad, C. R., & Chakradhar, A. (2020). Multi Faceted Impact of Small Group Work to Cooperative Learning: A Strategy for Course Design and Delivery. *Psychology and Education*, *57*(9), 556–561.

Greenstein, L. (2012). *Assessing 21st Century Skills: A Guide to Evaluating Mastery and Authentic Learning*. Company California: Corwin A Sage.

Hasugian, N. R. E., & Aryeni. (2017). Efektivitas Model Pembelajaran Kooperatif Tipe Quiz Team terhadap Hasil Belajar Biologi Siswa pada Materi Sistem Pernapasan Manusia di Kelas XI IPA SMA Dharma Pancasila Medan. *Jurnal Pelita Pendidikan*, *5*(4), 365–370.

Haya, N., M.Yohanita, A., Iwan, & Ruslan, S. (2018). Pengaruh Model Pembelajaran Kooperatif Tipe Team Quiz terhadap Hasil Belajar Kognitif Peserta Didik Materi Sistem Ekskresi Kelas XI MIA di SMA Negeri 01 Manokwari. *Jurnal Biology Science & Education*, *7*(1), 29–41.

Johnson, D. C. (2008). Thinking Critically Assessing Online Learning. *The International Journal of Learning*, *14*(12), 125–130.

Kisoglu, M. (2018). An Examination of Science High School Students' Motivation towards Learning Biology and Their Attitude towards Biology Lessons. *International Journal of Higher Education*, *7*(1), 151–164. https://doi.org/10.5430/ijhe.v7n1p151

Kohzadi, H., Azizmohammadi, F., & Samadi, F. (2014). Is there a Relationship Between Critical Thinking and Critical Reading of Literary Texts : A Case Study at Arak University (Iran). *International Letters of Social and Humanistic Sciences*, *33*, 63–76. https://doi.org/10.18052/www.scipress.com/ILSHS.33.63

Kurniawati, Z. L., Zubaidah, S., & Mahanal, S. (2016). Model Pembelajaran Remap CS (Reading Concept Map Cooperative Script) untuk Pemberdayaan Keterampilan Berpikir Kritis Siswa Remap CS (Reading Concept Map Cooperative Script) Learning Model to Empower Student's Critical Thinking Skills. *Proceeding Biology Education Conference*, *13*(1), 399–403.

Lalor, S. B., & Rainford, M. (2014). The Effects of Using Concept Mapping for Improving Advanced Level Biology Students' Lower and Higher Order Cognitive Skills. *International Journal of Science Education*, *36*(5), 839–864. https://doi.org/10.1080/09500693.2013.829255

Ludwig, J. (2021). An Experiment in Active Learning: The Effects of Teams. *International Journal of Educational Methodology*, *7*(2), 353–360. https://doi.org/10.12973/ijem.7.2.353

Machado, C. T., & Carvalho, A. A. (2020). Concept Mapping : Benefits and Challenges in Higher Education Concept Mapping : Benefits and Challenges in. *The Journal of Continuing Higher Education*, *68*(1), 38–53. https://doi.org/10.1080/07377363.2020.1712579

Mahanal, S., Zubaidah, S., Sumiati, I. D., Sari, T. M., & Ismirawati, N. (2019). RICOSRE : A Learning Model to Develop Critical Thinking Skills for Students with Different Academic Abilities. *International Journal of Instruction*, *12*(2), 417–434. https://doi.org/10.29333/iji.2019.12227a

Makmur, W., Susilo, H., & Indriwati, S. E. (2019). Implementation of Guided Inquiry Learning with Scaffolding Strategy to Increase Critical Thinking Skills of Biology Students' Based on Lesson Study. *Journal of Physics: Conference Series*, *1227*(1), 1–7. https://doi.org/10.1088/1742-6596/1227/1/012003

Nappi, J. S. (2017). The Importance of Questioning in Developing Critical Thinking Skills. *International Journal for Professional Educators*, *84*(1), 30–41.

Nuryanti, L., Zubaidah, S., & Diantoro, M. (2018). Analisis Kemampuan Berpikir Kritis Siswa SMP. *Jurnal Pendidikan: Teori, Penelitian, dan Pengembangan*, *3*(2), 155–158.

Onsee, P., & Nuangchalerm, P. (2019). Developing Critical Thinking of Grade 10 Students through Inquiry-Based STEM Learning. *Jurnal Penelitian dan Pembelajaran IPA*, *5*(2), 132–141.

Prasmala, E. R., & Tanggu, E. D. (2020). Modul Sistem Pencernaan dengan Model Pembelajaran Make a Match Berbasis Digital Daily Assasment Analysis of Development of Digestive System Module Needs Analysis with Make a Match Learning Model Based on Digital Daily. *PEDAGOGIA: Jurnal Pendidikan*, *9*(1), 91–97.

Puspita, A. S., & Aloysius, S. (2019). Developing Student's Critical Thinking Skills through Implementation of Problem Based Learning Approach. *Journal of Physics: Conference Series*, *1241*(1), 1–8. https://doi.org/10.1088/1742-6596/1241/1/012020

Rintaningrum, R. (2019). Explaining the Important Contribution of Reading Literacy to the Country's Generations: Indonesian's Perspectives. *International Journal of Innovation, Creativity and Change*, *5*(3), 936–953.

Rosyida, F., Zubaidah, S., & Mahanal, S. (2016). Memberdayakan Keterampilan Berpikir Kritis dengan Model Pembelajaran Remap TmPS (Reading Concept Map Timed Pair Share). *Proceeding Biology Education Conference*, *16*(1), 209–214.

Sakdiah, N. (2021). Peningkatan Aktivitas dan Hasil Belajar IPA pada Materi Sistem Reproduksi Manusia melalui Model Team Quiz Siswa Kelas IX-3 MTsN 5 Pidie. *Jurnal Pendidikan dan Pengabdian Vokasi*, *2*(1), 51–60.

Santosa, T. A., & Eria Marina Sepriyani. (2020). Analisis Masalah Pendidikan Biologi pada Sekolah Menengah Pertama di Era Pandemi Covid-19. *Jurnal Review Pendidikan dan Pengajaran*, *3*(2), 273–278.

Shen, K., Li, T., & Lee, M. (2018). Learning Biology as 'Increase Ones' Knowledge and Understanding': Studying Taiwanese High School Students' Learning Strategies in Relation to Their Epistemic Views and Conceptions of Learning in Biology. *International Journal of Science Education*, *40*(17), 2137–2157. https://doi.org/10.1080/09500693.2018.1522013

Sholihah, M., Zubaidah, S., & Mahanal, S. (2016). REMAP RT (Reading Concept Map Reciprocal Teaching) untuk Meningkatkan Keterampilan Berpikir Kritis Siswa. *Proceeding Biology Education Conference*, *13*(1), 280–284.

Shuaibu, A., & Ishak, N. A. (2020). Effect of The 7E Instructional Strategy on The Overall Attitude of Students in Biology in Public Secondary Schools in Adamawa State, Nigeria. *Asia Pacific Journal of Educators and Education*, *35*(2), 171–186. https://doi.org/doi: 10.21315/apjee2020.35.2.10

Silberman, M. L. (2006). *Training the Active Training Way: 8 Strategies to Spark Learning and Change*. San Francisco: Pfeiffer.

Suprijono. (2009). *Cooperative Learning Teori dan Aplikasi PAIKEM*. Surabaya: Pustaka Belajar.

Trilling, B., & Fadel, C. (2009). *21st Century Skills: Learning for Life in Our Times*. San Francisco: Jossey-Bass.

Tseng, S. (2019). Using Concept Mapping Activities to Enhance Students ' Critical Thinking Skills at a High School in Taiwan. *The Asia-Pacific Education Researcher*, *29*, 249–256. https://doi.org/10.1007/s40299-019-00474-0

Utami, D. A., Ramalis, T. R., & Saepuzaman, D. (2016). Penerapan Model Pembelajaran Inkuiri Abduktif untuk Meningkatkan Keterampilan Berpikir Kritis dan Penguasaan Konsep Siswa pada Materi Dinamika. *Jurnal Penelitian dan Pembelajaran IPA*, *2*(2), 176–185.

Vieira, R. M., & Vieira, C. T. (2014). Fostering Scientific Literacy and Critical Thinking in Elementary Science Education. *International Journal of Science and Mathematics Education*, *14*, 659–680. https://doi.org/10.1007/s10763-014-9605-2

Wang, A. Y. (2012). Exploring the Relationship of Creative Thinking to Reading and Writing. *Thinking Skills and Creativity*, *7*(1), 38–47. https://doi.org/10.1016/j.tsc.2011.09.001

Wegner, C., & Schmiedebach, M. (2020). Interest in Biology: Grade-dependent Differences and Benefits of Participating in Out of school Interventions. *International Journal of Research in Education and Science*, *6*(3), 427–434.

Xu, X., & Pang, W. (2020). Can Concept Mapping Facilitate Verbal Divergent Thinking ? Can Concept Mapping Facilitate Verbal Divergent Thinking ? *Creativity Research Journal*, *32*(4), 344–356. https://doi.org/10.1080/10400419.2020.1843124

Zubaidah, S. (2014). The Empowerment of Discovery Skills in Scientific Approach Through Remap Coople. *Seminar Nasional XI Pendidikan Biologi FKIP UNS*, 1000–1011.

Zubaidah, S. (2016). Keterampilan Abad Ke-21: Keterampilan yang diajarkan melalui Pembelajaran. *Seminar Nasional Pendidikan Program Studi Pendidikan Biologi STKIP Persada Khatulistiwa Sintang–Kalimantan Barat*, 1–17.

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. https://doi.org/doi: 10.12973/iji.2018.1124a

Zubaidah, S., Mahanal, S., Rosyida, F., Kurniawati, Z. L., Sholihah, M., & Ismirawati, N. (2018). Using Remap-TmPS Learning to Improve Low-Ability Students' Critical Thinking Skills. *Asia-Pacific Forum on Science Learning and Teaching*, *19*(1), 1–28.

Zubaidah, S., Mahanal, S., Sholihah, M., Rosyida, F., & Kurniawati, Z. L. (2020). Using Remap RT (Reading–Concept Mapping–Reciprocal Teaching) Learning Model to Improve Low-Ability Students' Achievement in Biology. *CEPS Journal*, *10*(3), 117–144. https://doi.org/10.26529/cepsj.777