Jurnal Ilmiah Profesi Pendidikan
Volume 8, Nomor 3, Agustus 2023
ISSN (Print): 2502-7069; ISSN (*Online*): 2620-8326

The Influence of The Reading Concept Mapping-Student Team Achievement Division (REMAP-STAD) Model on Students' Metacognitive Skills and Cognitive Learning Outcomes

Anindita Suliya Hangesti Mandra Kusuma[1] & Ahmad Busyairi[2*]
[1]Biology Education, Faculty of Teacher Training and Education, Mataram University, Indonesia
[2]Physics Education, Faculty of Teacher Training and Education, Mataram University, Indonesia
*Corresponding Author: ahmad.busyairi@unram.ac.id

Article History
Received: July 18th, 2023
Revised: August 12th, 2023
Accepted: August 18th, 2023

Abstract: Metacognitive skills and cognitive learning outcomes are two competencies that students should have after learning is carried out. However, in reality, the increase in these two competencies has so far not been optimal. This research aims to determine the effect of the Reading Concept Mapping-Student Team Achievement Division (Remap-STAD) learning model on students' metacognitive skills and cognitive learning outcomes. This type of research is quasi-experimental with the One-group Pretest-Posttest Design. The instrument used in this research is in the form of essay questions. The technique for assessing metacognitive skills and student learning outcomes is carried out in an integrated manner. Hypothesis testing was carried out using statistical tests by comparing two means (pretest mean and posttest mean) using Paired Samples t-test analysis. The results of data analysis show that there is an influence of the Remap-STAD learning model on students' metacognitive skills and cognitive learning outcomes. Thus it can be concluded that the Remap-STAD learning model can be used as an alternative learning to improve metacognitive skills and student learning outcomes in higher education.

Keywords: Reading Concept Mapping-Student Team Achievement Division, Remap-STAD, Metacognitive Skills, Cognitive Learning Outcomes.

INTRODUCTION

The Basic Natural Sciences (IKD) course summarizes basic concepts in various branches of natural science such as physics, chemistry, and biology. Basic physics includes the laws of motion, energy concepts, forces, and electrical-magnetic phenomena. Basic chemistry discusses atomic structure, chemical reactions, properties of substances, and others. On the biology side, this course explores cells as units of life, ecology, conservation, and organ systems in the human body. In addition, other aspects of the natural sciences, such as geology and astronomy, can also be part of the curriculum. This course not only presents scientific facts but also introduces students to scientific methods, observation, and data analysis. By providing a solid understanding of the basics of natural science, this course provides an important foundation for understanding further concepts in advanced courses as well as their applications in various fields of science and technology. Learning in basic natural sciences still uses conventional discussion methods and one-way explanations using power point media. Conventional discussions in IKD teaching focus on absorbing information about the concepts of the material taught in IKD courses without providing sufficient opportunities for students to develop their metacognitive skills.

Metacognitive skills are skills for generating feedback about the ongoing learning process (Stebner et al., 2022). Metacognitive skills can be thought of as the ability to apply metacognitive strategies. Metacognitive strategies involve planning, monitoring, evaluating, and regulating cognitive processes (Padmanabha, 2020). Planning refers to the forward-thinking phase of the self-directed learning cycle model while monitoring, evaluating, and organizing refer to the performance phase and self-reflection phase (Stebner et al., 2022). Metacognitive skills influence learning strategies that have the aim of processing learning tasks and the content of the information to be studied. Metacognitive Skills refer to planning, monitoring, evaluating, and revising activities (Schraw & Dennison, 1994; Thomas, et. al., 2008). Metacognitive skills involve procedural knowledge related to actual regulations, and control over one's cognitive processes and learning activities (Asy'ari & Ikhsan, 2019).

Students who have metacognitive abilities will be able to understand their academic strengths and weaknesses. Then, from their background knowledge, students can adjust their needs to meet the demands of certain tasks (Lestari, et.al, 2019; Permana & Chamisijatin, 2019). Metacognitive skills play an important role in monitoring and regulating cognitive processes and helping students understand when, why, where, and how to use their knowledge to solve problems successfully (Guner & Erbay, 2021). When students encounter obstacles in their work, they will rethink and revise based on the assignment goals.

Empowerment of metacognitive skills through the learning process is very necessary. As a result, students can be independent (Susantini, et.al, 2019). Darmawan, et.al., (2020) explained that metacognitive skills are related to procedural knowledge that complies with actual regulations, and control over one's cognitive and learning processes. These are also referred to as executive skills. Includes analyzing tasks, planning, monitoring, checking or evaluating, recapitulating, and reflecting that is realized in students when working on projects. Based on their knowledge and metacognitive skills, students can regulate their involvement in tasks to optimize learning processes and outcomes.

Learning outcomes are changes in students' knowledge, skills, and behavior that can be observed and measured. Learning outcomes are grouped into three objectives according to their development, including cognitive, psychomotor, and affective learning outcomes (Sari, et.al, 2023). Cognitive learning outcomes refer to the achievement and development of cognitive abilities or thinking processes possessed by individuals after participating in a program or learning experience (Shi, et.al, 2020). Cognitive refers to aspects such as understanding, knowledge, critical thinking, analysis, and evaluation of information (Shi, et.al, 2021). Cognitive learning outcomes reflect the extent to which someone has succeeded in mastering subject matter and developing complex thinking skills. This can be measured through exams, tests, projects, or other assignments that assess understanding and application of certain concepts. Evaluation of cognitive learning outcomes is crucial in assessing the effectiveness of an education system or learning program, as well as providing an overview of the extent to which students have achieved the learning goals that have been set (Hamilton, et.al, 2021). By understanding cognitive learning outcomes, educators can design more effective learning strategies and provide more targeted feedback to students to improve the quality of education.

In recent years, the Remap-STAD (Reading Concept Mapping-Student Team Achievement Division) learning model has emerged as an innovative approach to improving the quality of learning. ReMap combines concept map techniques with reading activities, while STAD emphasizes teamwork to achieve joint achievements. This combination shows promise in stimulating deep understanding, student engagement, and social skills development.

Reading has a close relationship with creating concept maps because the reading process involves understanding and organizing information (Adawiyah, et.al, 2021; Irawan, et.al, 2021). When reading, readers actively digest text, identify main ideas, and make connections to the information contained therein. Creating a concept map is a visualization method that allows readers to organize and present relationships between concepts or ideas in a topic systematically. By reading, readers can extract important information and organize it into the form of concept maps, creating visual images that aid understanding and retention of information. Concept maps help readers see relationships between concepts, understand information hierarchies, and organize knowledge in a structured manner. Therefore, reading and creating concept maps complement each other in improving understanding and processing of information, allowing readers to build a strong conceptual framework for a particular material or topic.

A meta-analysis study by Daniela, et. al., (2015), concluded that the use of concept maps as a training method for students can facilitate connections between new information and existing knowledge, thereby creating more meaningful learning and increasing student achievement. Furthermore, concept maps are proven to help students overcome difficulties in understanding concepts by integrating them to form a more comprehensive cognitive structure. Apart from that, concept maps also play a role in helping students respond to questions. According to Purwianingsih (2014), the cognitive process involving the preparation of concept maps by students can make a positive contribution to optimal cognitive learning outcomes. By

DOI: https://doi.org/10.29303/jipp.v8i3.1927

implementing the use of concept maps in learning, students' ability to understand concepts in depth can be improved. Regarding the combination of ReMap with STAD, STAD provides a platform for students to share and build knowledge together. They can help each other understand the text, share ideas for creating a concept map, and overcome difficulties in understanding the material. Therefore, the relationship between reading, concept mapping, and STAD creates a collaborative learning environment that supports students' holistic understanding through interaction between team members and the use of visual strategies.

Several studies have examined the positive influence of Remap-STAD on critical thinking skills, creative thinking, motivation, and scientific literacy (Zubaidah, et, al, 2018; Andariana, et.al, 2019; Adawiyah, et.al, 2021; Irawan, et. al, 2021; Irawan & Rafi'y, 2023). Remap-STAD also has a positive influence on cognitive learning outcomes (Adawiyah, et.al, 2021; Sari, et.al, 2023; Pangestuti, 2017; Ramadhan, et.al, 2017). However, not much research has explored the potential of ReMap-STAD in improving students' metacognition and cognitive learning outcomes at the tertiary level, especially in the context of basic natural sciences. Therefore, this research aims to investigate the effect of the REMAP-STAD learning model on students' metacognitive skills and cognitive learning outcomes in basic natural science lectures.

METHODS

The research method uses quasi-experimental quantitative research, the One-group Pretest-Posttest Design (Creswell, 2017; Leavy, 2022; Gopalan, 2020). In the research design used, students are given a pretest before learning, then during the lesson they are taught using the ReMap-STAD learning strategy, and at the end of the lecture they are given a posttest. The aim of the research is to determine the influence of the Reading Concept Mapping-Student Team Achievement Division (ReMap-STAD) learning strategy on student learning outcomes in Basic Natural Sciences lectures. Schematically, the research design can be seen in Figure 1 below.

O_1	X	O_2

(Creswell, 2017)

Figure 1. Research Design

The independent variable in the research is the Reading Concept Mapping-Student Team Achievement Division (ReMap-STAD) learning strategy and the dependent variable in this research is metacognitive skills and cognitive learning outcomes. Metacognitive skills are measured using an Achievement test integrated with learning outcomes tests. Metacognitive Skills assessment refers to the metacognitive skills assessment rubric developed by Corebima (Corebima, 2009), while cognitive learning outcomes assessment refers to the learning outcomes assessment rubric. Test the research hypothesis using statistical tests by comparing two means (pretest mean and post-test mean) using Paired Samples t-test analysis. Before testing the hypothesis, the data must be ensured that it meets the assumptions/prerequisites of the parametric statistical paired samples t-test, namely that the data has homogeneous variance and the data is normally distributed. The homogeneity test uses Levene's Test of Equality of Error Variances and the normality test uses the Shapiro-Wilk Test. The Shapiro-Wilk test is used to determine the normality of data distribution in small samples (less than 50) (Rees, 2001; Siebert & Siebert, 2017; Hahs-Vaughn & Lomax, 2020).

FINDINGS AND DISCUSSION

Findings

The data obtained from the research are metacognitive skill scores and cognitive learning outcomes. Changes in the average metacognitive skills score before learning (pretest) and after learning (posttest) can be seen in Figure 2.

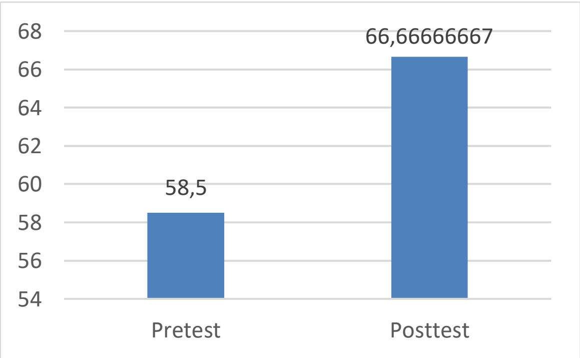

Figure 2. Average Pretest and Posttest Scores for Student Metacognitive Skills

Based on Figure 2, it is known that there was an increase in metacognitive skills scores after implementing the Reading Concept Mapping-Student Team Achievement

Division (Remap-STAD) learning strategy. Next, a normality assumption test was carried out using the Shapiro-Wilk Test. A summary of the data normality test can be seen in Table 1 below.

Table 1. Normality Test Results for Metacognitive Skills Data

Variabel	Factor	Shapiro-Wilk		
		Statistic	df	Sig.
Metacog_Skills	Pretest	.991	42	.986
	Posttest	.949	42	.058

Based on the Shapiro Wilk Test in Table 1, it is known that the sig. The normality of the metacognitive skills pretest data is 0.986 > 0.050 so it can be concluded that the student's metacognitive skills pretest data is normally distributed. Sig value. The normality of the metacognitive skills posttest data is 0.058 > 0.050, so it can be concluded that the metacognitive skills posttest data is normally distributed. After the normality test is carried out and the data is normally distributed, it is continued with the homogeneity test. The summary results of the data homogeneity test using Levene's Test can be seen in Table 2 below.

Table 2. Results of Homogeneity Test of Metacognitive Skills Data

Levene Statistic	df1	df2	Sig.
1.236	1	82	.269

Based on the homogeneity results in table 2, it can be seen that the sig. metacognitive skills data is 0.269 > 0.050 so it can be concluded that metacognitive skills data has a homogeneous variance. Because the assumptions of normal data distribution and homogeneous data variance are met, hypothesis testing is continued using parametric statistics, namely the Paired-samples t-test. A summary of the results of the paired-samples t-test (comparison of two means between pretest and posttest scores) of students' metacognitive skills can be seen in Table 3.

Table 3. Hypothesis Test Results Using Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	Posttest Pretest	8.16667	8.89208	1.37208	5.39570	10.93763	5.952	41	.000

Based on the results of hypothesis testing using paired samples t-test in Table 3, sig. 0.000 is smaller than alpha 0.050 (p < 0.050). This means that H0 which states that "there is no influence of the Reading Concept Mapping-Student Team Achievement Division (Remap-STAD) learning model on students' metacognitive skills" is rejected and Ha which states "there is an influence of the Reading Concept Mapping-Student Team Achievement Division learning model (Remap-STAD) on students' metacognitive skills" was accepted. Further analysis was carried out on data on student cognitive learning outcomes which were measured using essay tests. Changes in the average score of learning outcomes before learning (pretest) and after learning (posttest) can be seen in Figure 3.

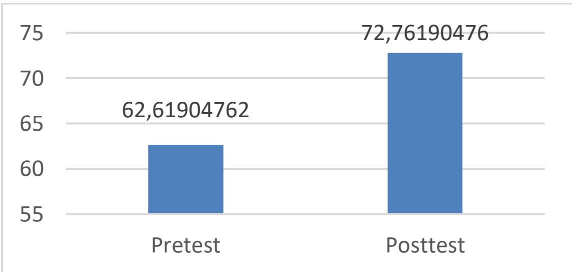

Figure 3. Average Pretest and Posttest Student Cognitive Learning Results

Based on Figure 3, it is known that there was an increase in scores after learning using the Reading Concept Mapping-Student Team Achievement Division (Remap-STAD) learning strategy. Next, a normality assumption test was carried out using the Shapiro-Wilk Test. A summary of the data normality test can be seen in Table 4 below.

Table 4. Normality Test Results of Cognitive Learning Results Data

Variabel	Factor	Shapiro-Wilk		
		Statistic	df	Sig.
Hasil	Pretest	.984	42	.810
Belajar	Posttest	.955	42	.098

Based on the Shapiro-Wilk Test in Table 4, it is known that the sig. The normality of the pretest learning outcomes data is 0.810 > 0.050 so it can be concluded that the pretest learning outcomes data is normally distributed. Sig value. The normality of the post-test learning outcomes data is 0.098 > 0.050, so it can be concluded that the post-test learning outcomes data is normally distributed. After the normality test is carried out and the data is normally distributed, it is continued with the homogeneity test. The summary results of the data homogeneity test can be seen in Table 5 below.

Table 5. Homogeneity Test Results of Cognitive Learning Outcome Data

Levene Statistic	df1	df2	Sig.
2.132	1	82	.148

Based on the results seen in Table 5, it can be seen that the sig. the learning outcome data is 0.148 > 0.050 so it can be concluded that the learning outcome data has a homogeneous variance. Because the assumptions of normal data distribution and homogeneous data variance are met, hypothesis testing is continued using parametric statistics, namely the Paired-samples t-test. A summary of the results of the paired-sample t-test (comparison of two means between pretest and posttest scores) of student learning outcomes can be seen in Table 6.

Table 6. Hypothesis Test Results Using Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	Posttest Pretest	10.14286	8.66327	1.33677	7.44319	12.84252	7.588	41	.000

Based on the results of hypothesis testing using paired samples t-test in Table 3, sig. 0.000 is smaller than alpha 0.050 ($p < 0.050$). This means that H0 which states that "there is no influence of the Reading Concept Mapping-Student Team Achievement Division (Remap-STAD) learning model on students' cognitive learning outcomes" is rejected and Ha which states "there is an influence of the Reading Concept Mapping-Student Team Achievement learning model Division (Remap-STAD) on student cognitive learning outcomes" was accepted.

Discussion

The Influence of Remap-STAD on Metacognitive Skills

The results of the hypothesis test show that there is an influence of applying the Remap-STAD model on students' metacognitive skills. The Reading Concept Mapping Student Team Achievement Division (Remap-STAD) learning model has a significant influence on the development of students' metacognitive skills. Remap-STAD is a learning model that integrates reading concepts with concept mapping and student group work.

Reading and making concept maps has a strong influence on the development of students' metacognitive skills, especially in the aspects of planning, monitoring, evaluating, and revising. When students engage in reading, they naturally build their understanding of the material presented. Reading provides a foundation for the metacognitive planning process, where students can develop mental schemas and conceptual frameworks. Effective reading also requires continuous self-monitoring, in which students actively check their understanding and adjust their reading strategies as needed.

Reading is an activity carried out to obtain information from reading sources. In the reading process, there is self-regulation which is one part of metacognition (Rosyida, et.al., 2016). Self-regulation is a person's ability to regulate and manage their own cognitive processes, including planning, monitoring, evaluating, and revising. Reading can train students to develop metacognitive skills by means of students being able to adjust how they read so that they can better understand the main idea or content of a reading (Antika, et al., 2015).

Reading activities in the Remap-STAD learning model are carried out independently at home before the learning process in class is carried out. Lecturers only play the role of giving assignments and facilitating students regarding reading sources that are relevant to the assignments given. Students are allowed to plan the steps or strategies needed to complete the given assignment. This of course makes students' metacognitive skills develop, especially in the aspect of planning skills.

Reading comprehension requires the application and articulation of word recognition and listening comprehension skills, and in turn, the development of reading comprehension can help further develop word recognition skills (Tunmer & Hoover, 2020). Students with good levels of comprehension not only read more texts, but also read more challenging texts. As a result, they encounter comprehension gaps more often and thus have more opportunities to test the application of different reading strategies to restore a coherent representation of the text (Muijselaar et al., 2017).

Metacognitive monitoring and control both play an important role in reading comprehension, and reading goals, and there are promising techniques for improving students' metacognition as they read (Cromley, 2023). Metacognitive processes involve cognitive efforts that include understanding and regulating cognitive processes (Muhid, et.al, 2023). It plays a key role in determining the success rate of understanding. Metacognitive reflects the reader's ability to monitor and control their reading strategies (Muhid, et.al, 2023). Students who have the awareness and ability to control metacognitive behavior when reading can benefit because they can continuously monitor understanding, identify difficulties, and recover the process when they experience failure (Muhid, et.al, 2023).

Creating concept maps is a powerful visual tool for representing relationships between concepts and helping students organize information better (Welter, et.al, 2022. The process of creating concept maps involves deep reflective thinking, allowing students to evaluate the information structure and conceptual relationships between the ideas they learn (Gunduzalp, 2023). Thus, metacognitive evaluation skills develop, as students learn to identify strengths and weaknesses in their own understanding. Additionally, metacognitive revision skills are strengthened through the use of concept maps.

When students look back at their concept maps, they can identify areas that need improvement or changes. This revision process encourages the development of deeper understanding and more integrated concepts. Thus, reading and creating concept maps work together to improve students' metacognitive skills in planning, monitoring, evaluating, and revising, helping them become more independent and effective learners.

Through concept maps, students can also clarify and refine (revise) the concepts they obtain. Concept maps can be used as a tool for students to test their own knowledge and help to identify something they don't know (Gurlitt and Renkl, 2009). Concept maps can train students to correct and reflect on their own understanding regarding the relationship between one concept and another so that they can improve their understanding of the concept (Vanides et al., 2005). Students' ability to correct and revise erroneous understanding is part of metacognitive skills.

The integration of Remap with the STAD cooperative learning model aims to condition students not only to understand the text individually but also to work together in groups to create concept maps that reflect their understanding (Adawiyah, et.al, 2021; Irawan, et.al, 2021). Through group discussions, students can also develop critical thinking skills and understand different perspectives. ReMap-STAD also encourages students to manage time effectively, develop appropriate learning strategies, and increase their understanding of thought processes. In this context, metacognition is not only the result of learning but also a process involved during interactions in groups and the preparation of concept maps. In addition, Remap-STAD provides opportunities for students to monitor their own and group learning progress, increasing their understanding of each individual's strengths and weaknesses in achieving shared learning goals. This triggers metacognitive reflection, where students can recognize effective learning strategies and make adjustments based on their learning experiences.

The research results of Antika, et. al., (2015) also show that the Remap-STAD learning model can improve students' metacognitive skills. Overall, the ReMap-STAD learning model not only improves students' understanding of reading material but also positively influences the development of metacognitive skills. Through the integration of reading concepts, concept mapping, and group work, this model creates a learning environment that supports the development of their metacognitive skills, providing a positive impact on students' ability to manage and improve their learning process.

The Influence of Remap-STAD on Cognitive Learning Outcomes

The results of the hypothesis test show that there is an influence of the application of the Remap-STAD model on student cognitive learning outcomes. Remap-STAD is a learning model whose activities provide opportunities for students to read (reading process) then students are asked to create concept maps from the content they have read and apply STAD during classroom learning. These activities can certainly empower students' cognitive learning outcomes.

Apart from being able to improve students' metacognitive skills, reading activities can also improve their cognitive learning outcomes. The learning outcomes referred to here start from the ability to remember (C1), understand (C2), apply (C3), analyze (C4), evaluate (C5), and create (C6). Reading is an activity that involves cognitive processes in which the reader actively produces meaning through a series of mental processes. Reading can at least activate memory so that what is read is stored in memory and can be recalled at any time in the problem-solving process. Memory is the building block of mental structures, built by mapping incoming information such as sentences onto mental structures. Comprehension involves mental processes, which differ from one reader to another (Shihab, 2011).

The mapping concept in Remap-STAD helps students understand and organize the information contained in the reading text. By combining these learning strategies in teams, students can collaborate in constructing concept maps that facilitate deeper understanding (Sari, et.al, 2023; Adawiyah, et.al, 2023; Yolanda, 2023). First of all, through this learning model, students can improve their reading skills. Concept mapping helps them identify relationships between ideas, understand text structure, and extract key information. As a result, students can more effectively extract meaning from reading and develop a deeper understanding of the learning material (Hoppe & Gabner, 2023).

Pangestuti (2014) explains that through preparing concept maps students can understand and remember a large amount of information related to the concepts they learn while reading. Concept maps are an active learning tool that includes mind mapping. The use of concept maps is considered suitable for use in the thinking process, formulating ideas, and can help students in reading, writing and thinking (Maas & Leauby 2005).

The use of concept maps is very helpful for organizing concepts that have been read and understood by students. When students create concept maps, they can assess or evaluate the extent to which they understand what they have read. The ability of each individual to assess the extent of their understanding is part of metacognitive skills. Therefore, the activity of making concept maps in the Remap-STAD model can further improve students' metacognitive skills when compared to conventional learning whose activities are more lecturer-centered. One of the benefits of preparing another concept map is that it can help students understand concepts and their relationships with each other (Patrick, 2011). Through making concept maps, students can organize, connect, and synthesize information or concepts that exist in their cognitive structure so that they can understand concepts and relationships between concepts better (Vanides, et. al., 2005; Kinchin & Hay, 2000; Edmonson & Smith, 1996). This is what supports improving student cognitive learning outcomes with the Remap-STAD model.

In the Remap-STAD learning model in this research, reading activities carried out independently outside the classroom before the classical learning process is carried out provide students with knowledge related to the material to be studied so that students will more easily understand the material provided in class (Zubaidah, 2018). That way students will have insight first, and can easily understand the concept. According to the view of cognitivist learning theory, the initial knowledge that exists in a person's cognitive structure is known as schemata. The better and more complete the schemata a person has, the faster the assimilation and accommodation process will be in their cognitive structure so that the person's cognitive development process will be more effective and optimal. Therefore, in general, reading activities before the learning process in this class really support improving student learning outcomes from cognitive level C1 to cognitive level C6.

Apart from that, this approach also increases involvement and collaboration between students in teams. By working together to create concept maps, students can teach and learn from each other. This process not only deepens each individual's understanding but also strengthens connections between team members, creating a collaborative and interactive learning environment.

In the context of team achievement, this learning model can produce better achievements. Collaboration in creating concept maps can result in a more comprehensive understanding of the topic, and this can be reflected in the results of the cognitive evaluation. Students will have the ability to connect information, analyze concepts, and apply their knowledge more comprehensively in academic assessments

Overall, the ReMap-STAD learning model not only improves students' reading skills and cognitive understanding but also fosters positive team collaboration. In this way, students not only achieve higher personal achievements but also develop social and collaborative skills that are valuable in the context of their education and professional future. Apart from reading activities and making concept maps, in the Remap-STAD model learning continues by implementing STAD-type cooperative learning.

STAD is a type of cooperative learning that emphasizes interaction between students to motivate each other and help each other master the material and achieve maximum achievement (Arends, 2008). In STAD, lecturers divide students into small groups (4-5 students) so as to provide opportunities for all students to be involved in learning (Ocampo & Ocampo, 2015). In group discussions, students exchange ideas and understandings, allowing each other to correct and argue so that evaluation, correction, and evaluation processes are very likely to occur in groups and in class discussions. In class discussions (the presentation of each group in front of the class), giving each student the opportunity to convey the results of their thoughts so that they can be understood by other groups is learning that makes students aware of their own cognitive abilities. The results of this research are in line with the research of Darwis, et. al., (2021); Ramadhan, et al., 2017); and Pangestuti (2017) show that the Remap-STAD model can improve student learning outcomes.

CONCLUSION

The results of data analysis show that there is an influence of the Remap-STAD learning model on students' metacognitive skills and cognitive learning outcomes. Thus it can be concluded that the Remap-STAD learning model can be used as an alternative learning to improve metacognitive skills and student learning outcomes in higher education.

This research only used one class so there was no comparison class. Therefore, researchers suggest that research can be carried out by including a comparison class. Apart from that, it is also recommended for further research to see the extent of the correlation between metacognitive skills and student cognitive learning outcomes.

ACKNOWLEDGMENT

We would like to express our thanks to all parties, whom it is impossible to mention one by one, who have provided invaluable assistance during the entire research process until the completion of this article.

REFERENCES

Adawiyah, R., Zubaidah, S., Listyorini, D., & Astriani, M. (2021, March). The potential of Remap STAD in improving motivation and academic achievement. In *AIP Conference Proceedings* (Vol. 2330, No. 1). AIP Publishing.

Andariana, A., Zubaidah, S., Mahanal, S., & Suarsini, E. (2019, July). Incorporating Remap-STAD Into Learning Cycle 5E to Improve Preservice Biology Teachers' Critical Thinking Skills. In *Proceedings of the 3rd International Conference on Education and Multimedia Technology* (pp. 114-119).

Antika, L. T., Corebima, A. D., dan Zubaidah, S. (2015). Pengaruh Pembelajaran Biologi berbasis Reading-Concept Map-STAD terhadap Keterampilan Metakognitif dan Hasil Belajar Kognitif Siswa Kelas X SMA Malang. *Prosiding Seminar Nasional Pendidikan Biologi, Symposium on Biology Education (Symbion) di Universitas Ahmad Dahlan Jogjakarta*, 150-157.

Asy'ari, M., & Ikhsan, M. (2019). The Effectiveness of Inquiry Learning Model in Improving Prospective Teachers' Metacognition Knowledge and Metacognition Awareness. *International Journal of Instruction*, *12*(2), 455-470.

Corebima, A. D. (2009). Metacognitive skills measurement integreted in achievement test. Paper presented at Third International Conference on Science and Mathematics Education (CosMed). Malaysia, 10-12 November.

Corebima, A.D. 2016. Pembelajaran Biologi di Indonesia Bukan untuk Hidup. Makalah utama disajikan dalam Seminar Nasional XIII Biologi, Sains, Lingkungan, dan Pembelajarannya di Pendidikan Biologi FKIP UNS. Solo, 6 Agustus.

Creswell, J. W., & Creswell, J. D. (2017). *Research design: Qualitative, quantitative, and mixed methods approaches*. Sage publications.

Cromley, J. G. (2023). Metacognition, cognitive strategy instruction, and reading in adult literacy. In *Review of Adult Learning and Literacy, Volume 5* (pp. 187-204). Routledge.

Daniela, C. C., Propescu, F. F, Ioan, P. A., Andrei, V. 2015. Conceptual Maps and integrated Experiments for Teaching/Learning Physics of Photonic Devices. Procedia-Social and Behavioral Sciences 191 2015: 512-518.

Darmawan, E., Zubaidah, S., Ristanto, R. H., Zamzami, M. R. A., & Wahono, B. (2020). Simas Eric Learning Model (SELM): Enhance Student Metacognitive Skill Based on the Academic Level. *International Journal of Instruction*, *13*(4), 623-642.

Darwis, N.A., Salahudin, & Zulkarnaim, (2021). Pengaruh Model Pembelajaran Remap-STAD Terhadap Hasil Belajar Kognitif Peserta Didik Pada Materi Sistem Ekskresi Kelas XI SMAN 2 Gowa, *Jurnal Al-Ahya*, 3 (1), 29-39.

Edmondson, K. M. & Smith, D. F. (1996). Concept map to Facilitate Veterinary Students' Understanding of Fluidand Electrolyte Disorders. *Annual Meeting of the American Education Research Association*. New York.

Gopalan, M., Rosinger, K., & Ahn, J. B. (2020). Use of quasi-experimental research designs in education research: Growth, promise, and challenges. *Review of Research in Education*, *44*(1), 218-243.

Gündüzalp, C. (2023). Using the Mind Mapping Method in Web-Based Teaching: Pre-Service Teachers' Metacognitive Learning Strategies and Self-Directed Learning Skills. *Journal of Theoretical Educational Science*, *16*(1), 218-241.

Güner, P. & Erbay, H. N. (2021). Metacognitive skills and problem-solving. International Journal of Research in Education and Science (IJRES), 7(3), 715-734. https://doi.org/10.46328/ijres.1594

Gurlitt, J. & Renkl, A. 2009. Prior Knowledge Activation: How Different Concept Mapping Tasks Lead to Substantial Differences in Cognitive Processes, Learning Outcomes, and Perceived Self-Efficacy. *Instructional Science: An International Journal of the Learning Sciences*, 38 (4), 417-433.

Hahs-vaughn, D. L & Lomax, R. G. (2020). *Statistical Concepts: A Second Course*. NY: Routledge.

Hamilton, D., McKechnie, J., Edgerton, E., & Wilson, C. (2021). Immersive virtual reality as a pedagogical tool in education: a systematic literature review of quantitative learning outcomes and experimental design. *Journal of Computers in Education*, *8*(1), 1-32.

Hoppe, H. U., & Gabner, K. (2023, January). Integrating collaborative concept mapping tools with group memory and retrieval functions. In *Computer Support for Collaborative Learning* (pp. 716-725). Routledge.

Irawan, F., & Rafi'y, M. (2023). Pengaruh Model Pembelajaran REMAP STAD dalam Melatih Keterampilan Literasi Sains Peserta Didik. *Indo-MathEdu Intellectuals Journal*, *4*(2), 683-694.

Irawan, F., Zubaidah, S., & Sulisetijono, S. (2020). Pengaruh Model Pembelajaran Remap STAD Terhadap Pemberdayaan Keterampilan Literasi Sains Peserta Didik. *Jurnal Pendidikan: Teori, Penelitian, Dan Pengembangan*, *5*(8), 1086-1092.

Irawan, F., Zubaidah, S., Sulisetijono, S., & Astriani, M. (2021, March). Does Remap-STAD have the potential to promote students' creative thinking skills?. In *AIP Conference Proceedings* (Vol. 2330, No. 1). AIP Publishing.

Kinchin, I. M. dan Hay, D.B. (2000). How Qualitative Approach to Concept Map Analysis Can Be Used to Aid Learning by Illustrating Patterns of Conceptual Development. *Educational Research*, 42 (1): 43-57.

Leavy, P. (2022). *Research design: Quantitative, qualitative, mixed methods, arts-based, and community-based participatory research approaches*. Guilford Publications.

Lestari, P., Ristanto, R. H., & Miarsyah, M. (2019). Metacognitive and conceptual understanding of pteridophytes: Development and validity testing of an integrated assessment tool. *Indonesian Journal of Biology Education*, *2*(1), 15-24.

Maas, J.D. & Leauby, B.A. (2005). Concept Mapping Exploring Its Value as A Meaningful Learning Tool In Accounting Education, *Global Perspectives on Accounting Education*, 2 (1), (75-98).

Muhid, A., Amalia, E. R., Hilaliyah, H., Budiana, N., & Wajdi, M. B. N. (2020). The Effect of Metacognitive Strategies Implementation on Students' Reading Comprehension Achievement. *International Journal of Instruction*, *13*(2), 847-862.

Muijselaar, M. M., Swart, N. M., Steenbeek-Planting, E. G., Droop, M., Verhoeven, L., & de Jong, P. F. (2017). Developmental relations between reading comprehension and reading strategies. *Scientific Studies of Reading*, *21*(3), 194-209.

Ocampo. R. O & Ocampo. R. B. (2015). Effectiveness Students' Team Achievement Division on Students' Attidue Towards Physics. *Asia Pacific Journal of Multidisciplinary Research*, 3 (4), 112-117.

Padmanabha, C. H. (2020). Metacognition: conceptual framework. *Journal on Educational Psychology*, *14*(1), 1-11.

Pangestuti, A. A. (2017). Penerapan model pembelajaran biologi berbasis remap-stad untuk meningkatkan kemampuan berpikir kritis dan hasil belajar kognitif mahasiswa ikip budi utomo malang. *Edubiotik: Jurnal Pendidikan, Biologi Dan Terapan*, *2*(01), 13-22.

Patrick, A. O. (2011). Concept Mapping as a Study Skill: Effect on Student Achievement in Biology. *International Journals of Education Science*, 3 (1), 49-57.

Permana, F. H., & Chamisijatin, L. (2019). Project-based learning through edmodo: improving critical thinking and histology concepts. *Biosfer: Jurnal Pendidikan Biologi*, *12*(1), 58-69.

Purwianingsih, W., Maesaroh, T., & Surakusumah, W. (2014). The Effectiveness of Concept Map as A Learning Strategy and Evaluation Tools to Improve Students' Mastery of Excretory System Concept in Junior High School. *Proceeding Biology Education Conference*, 11 (1), 1117-11124.

Ramadhan, F., Mahanal, S., & Zubaidah, S. (2017). Meningkatkan hasil belajar kognitif siswa melalui model pembelajaran Biologi REMAP STAD. *Jurnal Pendidikan: teori, penelitian, dan pengembangan*, *2*(5), 610-615.

Rees, D. G. (2001). *Essentials Statistic 4th Edition*. NY: Chapman & Hall.

Rosyida, F., Zubaidah, S., & Mahanal, S. (2016). Keterampilan Metakognitif dan Hasil Belajar Kognitif Siswa Dengan Pembelajaran Reading Concept Map-Timed Pair Share (Remap-TMPS). *Jurnal Pendidikan: Teori, Penelitian, danPengembangan,* 1(4), 622-627.

Sari, T. M., Ernawati, E., & Amaliah, N. (2023). Application of Remap-STAD Learning Model to Improve Student Cognitive Learning Outcomes in Teaching and Learning Strategy Course. *Indonesian Journal of Educational Science (IJES)*, *5*(2), 127-133.

Schraw, G., & Dennison, R. S. (1994). Assessing metacognitive awareness. *Contemporary educational psychology*, *19*(4), 460-475.

Shi, Y., Ma, Y., MacLeod, J., & Yang, H. H. (2020). College students' cognitive learning outcomes in flipped classroom instruction: a meta-analysis of the empirical literature. *Journal of Computers in Education*, *7*, 79-103.

Shi, Y., Zhang, J., Yang, H., & Yang, H. H. (2021). Effects of interactive whiteboard-based instruction on students' cognitive learning outcomes: a meta-analysis. *Interactive Learning Environments*, *29*(2), 283-300.

Shihab. I. A. (2011). Reading as Critical Thinking. *Asian Social Science*. 7 (8), 209-2018.

Siebert, C. F., & Siebert, D. C. (2017). *Data analysis with small samples and non-normal data: Nonparametrics and other strategies*. Oxford University Press.

Stebner, F., Schuster, C., Weber, X. L., Greiff, S., Leutner, D., & Wirth, J. (2022). Transfer of metacognitive skills in self-regulated learning: Effects on strategy application and content knowledge acquisition. *Metacognition and Learning*, *17*(3), 715-744.

Susantini, E., Indana, S., Isnawati, I., & Nursanti, A. (2019). Enabling Indonesian Pre-Service Teachers to Design Biology Learning Tools Using Metacognitive Strategy. *Jurnal Pendidikan IPA Indonesia*, *8*(3), 391-397.

Thomas, G., Anderson, D., & Nashon, S. (2008). Development of an instrument designed to investigate elements of science students' metacognition, self-efficacy and learning processes: The SEMLI-S. *International Journal of Science Education*, *30*(13), 1701-1724.

Tunmer, W. E., & Hoover, W. A. (2019). The cognitive foundations of learning to read: A framework for preventing and remediating reading difficulties. *Australian Journal of Learning Difficulties*, *24*(1), 75-93.

Vanides, J., Yin, Y., Tomita, M., & Ruiz-Primo, M.A. (2005). Using Concept Maps in the Science Classroom. *Science Scope*, 28 (8), 37-38.

Vanides, J., Yin, Y., Tomita, M., & Ruiz-Primo, M.A. (2005). Using Concept Maps in the Science Classroom. *Science Scope*, 28(8): 37-38.

Welter, V. D. E., Becker, L. B., & Großschedl, J. (2022). Helping learners become their own teachers: The beneficial impact of trained concept-mapping-strategy use on metacognitive regulation in learning. *Education Sciences*, *12*(5), 325.

Yolanda, E. M. Y. (2023). *Meningkatkan motivasi belajar dan hasil belajar siswa kelas x sma panjura malang melalui model remap stad/Esther Margaretha Yolanda* (Doctoral dissertation, Universitas Negeri Malang).

Zubaidah, S., Mahanal, S., Ramadhan, F., Tendrita, M., & Ismirawati, N. (2018). Empowering critical and creative thinking skills through REMAP STAD learning model. In *Proceedings of the 2nd International Conference on Education and Multimedia Technology*, 75-79.