



## The effect of mnemonics method on students' retention and learning outcomes in the learning of biology

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### ABSTRACT

The mnemonic method is one of the procedures that is considered effective for improving students' learning outcomes and memory. This study aims to examine the effectiveness of the mnemonics methods in improving students' retention and learning outcomes in Biology class on the System of Biological Classifications. The pre-experimental method with one group of pre-test and post-test design was applied in this study. Thirty students of a secondary school in Pontianak were used as research samples taken by using intact group random sampling. The learning outcomes test used was 20 multiple-choice questions with four options having a validity level of 0.86 and a reliability of 0.87. Based on the data analysis, it was concluded: (1) the average learning outcomes before treatment was 48.50 and after treatment was 72.50; (2) the differences in the average student learning outcomes before treatment was = 48.50 and after treatment was = 72.50 ( $t = 5.517$ ,  $p < 0.05$ ); (3) the level of increase in retention power after treatment of  $R = 0.85.06\%$  is high. It is recommended that Science-Biology teachers apply mnemonics in a varied and sustainable manner to make it more useful and according to the content of the teaching material to be taught.

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## INTRODUCTION

The ability to remember is needed by students in the process of thinking and learning (Habsari, Karyanto & Probosari, 2012). An individual's memory can be seen from his ability to store information that has been received and can recall it in the future. This storage process is related to how this information can be received, constructed, and finally stored in the individual's mind (Rahman, 2002).

Remembering is a complex collection of electrochemical reactions that are activated through multiple sensory channels and stored in a highly complex and unique neural network throughout the brain. This dynamic nature of memory continues to change and develop in line with the increase in stored information (Lestari, 2010). Remembering (recall) is the process of remembering information (Ramachandra & Rahim, 2004). The information that has been obtained will be processed in memory through certain stages. So, memory is not something that happens instantly but requires a certain process or strategy to acquire it. Remembering is considered an effective way to transfer information from short-term memory to long-term memory (Putnam, 2015) so that in the learning process it is easier to achieve learning goals. According to Ahmadi (2009), the existence of the ability to remember in humans means that there is an indication that humans can store and recreate something that has been experienced. However, in general, humans are easy to forget something that has happened to them. The ability to remember each individual is different. The ability to remember can be improved through the process of taking notes (Arslan, 2002).

The ability to remember students depends on the learning methods used by the teacher and the exercises used with these methods to be effective in the learning process. One way that teachers or students can do this is to use the mnemonic method (Bakken, 2011; Shah, 2010). The mnemonic method is a way to store information (in the brain) easily and quickly to be recalled. Mnemonics strategies can build relationships so that the objects studied are not only memorized by rote, but also with conceptual relationships (Joyce (in Emalia, Juanengsih, & Siregar, 2019). The methods used to improve memory are requiring the brain's ability to connect words, ideas, and fantasies so that it is useful for solving problems (problems) which then arrive at understanding a concept. Mocko, Lesser, Wagler & Francis (2017) assert that mnemonics are very useful for helping students remember information (recall information) and can reduce stress.

From the results of an interview with one of the science teachers at the secondary school (June 22, 2021), information was obtained that the majority of teachers' teaching methods still use the lecture method. These results were relevant to many previous studies in Indonesia. It was noted that seventh-grade students complained that some biology material was not fun to learn using the lecture method which tends to require memorization skills. The difficulty in understanding biology teaching material is admitted by students that they often face when studying material on the System of Biological Classification for the taxonomic level. The majority of students' errors were confused with the taxonomic order. As a result, student learning outcomes in the formative test of the material System of Biological Classification have not reached the Standard of Minimum Competency (KKM) at the school, which is 80. Even though the material for the System of Biological Classification is one of the important materials in science lessons (Depdiknas, 2013). Based on observations from the documentation of daily test scores, students' data (learning outcomes) on the material System of Biological Classification are classified as low. This is indicated by the average daily test results for the System of Biological Classification in the seventh grade of 73.30 (with a score interval of 25-95) and with an average percentage of completeness of 40.35%.

The low-learning outcomes and memory achieved by seventh-grade students at the secondary school Pontianak above indicate that there are learning difficulties that need to be found alternative solutions. For example, by using other teaching methods. According to Djamarah (2010), one of the causes of forgetting is that the information received by students is not pleasant. By applying appropriate teaching methods, students are expected to obtain optimal learning outcomes. Syah (2010) stated that educators need to make variations in the teaching and learning process to attract students' interest in the lesson. Educators must prepare special efforts to make learning more effective and fun so that students can easily remember teaching materials. One of them is by applying the mnemonics method.

Manalo (2002), states that the implementation of mnemonics strategies has been applied in the field of education in the last few decades. According to Lubin & Polloway (2016), the mnemonics method can be applied to all science and social learning teaching materials. Hardi's research (2008) concluded that the mnemonics method in the experimental group was more effective in improving memory ability

than the control group that did not use mnemonics (conventional) methods. The research of Kurniawan and Nugrahalia (2014) concluded that the use of mnemonics methods can improve students' memory in biology subjects on the subject matter of the plant world (Plantae). Azmi, Najmi, & Rouyan's (2016) research in Malaysia, concluded that the mnemonics method is effective in increasing English vocabulary in elementary schools.

Based on the tracking study in several scientific research journals, the effect of using the mnemonic method on improving learning outcomes and retention in Biology class on the System of Biological Classification at the junior high school level has not been widely carried out. This study was conducted to test the effectiveness of using mnemonics methods in improving students learning outcomes and retention in Biology class on the System of Biological Classification at the school.

## METHODS

### Research Design

The form of research was pre-experimental with one group pretest-posttest designs (Sugiyono, 2016). The research paradigm referred to is presented in Table 1.

**Table 1**

Timelines of the Study

Research Phases	Time of Conduct
Pre-Test (T <sub>1</sub> )	March 15, 2021
Treatments	From June 22 - September 28, 2021
Immediate Post-Test (T <sub>2</sub> )	September 30, 2021
Delayed Post-Test (T <sub>3</sub> )	October 12, 2021

### Population and Samples

The target population in this study were all seventh-grade students of the school in the academic year of 2020/2021 whose characteristics were that they had not studied the material (i.e., System of Biological Classification) were not transferred students, and did not fail a grade with a total of 278 students. Thirty-two students in the seventh-b grade of the school were taken using the intact group random sampling technique. The entire students of the class of this study were drawn from the eight classes of the school.

### Instrument

The instruments used in this research were: (1) a set of lesson plans/RPP; (2) Student Worksheets; (3) a Learning Outcomes Test in the System of Biological Classification material used in the initial test, final test, and delayed test; and (4) Learning media in Powerpoint which includes contains material on the System of Biological Classification along with examples of mnemonic notes. The process of developing the research instrument involved five experts, two were the Lecturers of Biology Education FKIP Untan and the other three were science teachers from 3 different secondary schools in Pontianak to validate the learning tools, student worksheet (LKPD), and learning outcomes tests. From the validation process, it was concluded that the Lesson Plans (RPP) and their supporting worksheets were feasible to use. From the trial and error process, the learning outcomes test had a validity level of 0.86 (high) and 0.87 reliability (high).

### Procedure

The learning activity for the System of Biological Classification using the Mnemonics technique in this study follows the core steps (i.e., syntax) or the stages of the Direct Instruction model whose operationalization is as follows:

- a. Demonstrating (modeling) knowledge or skills. The teacher explains the teaching material and provides examples of Mnemonics techniques according to the content of the teaching material. Among them, for example, the Technique Acronym: mejikuhibinu (to remember the colors of the rainbow). Peg technique: convex (to remember a mirror or convex lens).
- b. Guiding training. Encourage students to study and well understand the content of teaching materials and guide the students to take notes or mnemonic forms individually.

- c. Check the students' understanding and provide feedback on examples of mnemonic notes made or constructed by students.
- d. Provide question items for the implementation and further training in the form of multiple-choice with four options of 15 questions items per meeting (3 meetings @ 90 minutes).

### Data Analysis Techniques

The use of data analysis was carried out after testing the assumptions of data normality and homogeneity of variance of the data groups to be compared. If the two groups of data to be compared are normally distributed and have homogeneous variances, then the difference test would use a paired-sample parametric statistics t-test. On the other hand, if one was not normal, the difference test would use the nonparametric Wilcoxon test. Analysis of normality test, homogeneity of variance test, and different tests using the SPSS program.

To analyze the occurrence of retention, the delay test average would be compared with the initial test average. If the difference between the two averages was significant, it could be concluded that classically or individually students experience retention. The level (category) of memory (retention) after using mnemonics techniques on the Material System of Biological Classification used the formula:  $\text{Memory/retention (R)} = \frac{\text{delayed test score}}{\text{immediate test score}} \times 100\%$  (Setiawan, Sutarto, Indrawati, 2012) with category interpretation as follows,  $R \geq 70$ : high category;  $60 < R < 70$ : medium category;  $R \leq 60$ : low category.

## RESULTS AND DISCUSSION

After testing the normality of the data (using the Kolmogorov-Smirnov test), it was concluded that the data (data) on the initial test, post-test, and delay test were normally distributed. The homogeneity of variance test (using Levene's test) concluded that the two groups to be compared had homogeneous variances. Thus, the difference in the average score of student learning outcomes using the paired-samples t-test parametric test.

### 1. Differences in the Average Score of Learning Outcomes Before and After the Use of Mnemonics Techniques

To test whether there was a difference between the average learning outcomes scores before and after the use of the Mnemonics Technique, the data (scores) were analyzed using a paired-sample t-test parametric test, the results of which are presented in [Table 2](#).

The research hypotheses tested were as follows:

- a. The average score of student learning outcomes on the final test was significantly different from the average score for the initial test of the study.
- b. The average score of student learning outcomes on the delayed test was significantly different from the average score of the initial research test.

**Table 2**

Test results of Average difference between Pre-Test Score and Post-Test Score

Test	Average score	SD	t	Sig	Results
Initial	48.50	14.98	5.517	0.000	Reject Ho
Immediate	72.50	17.94			

Based on [Table 2](#), it was found that the average results before and after using the Mnemonics technique were 48.50 and 72.50, respectively. There was an increase in the average learning outcomes of 24.00. It can be concluded: There is a significant difference between the average learning outcomes on the initial test and the immediate post-test (sig:  $p < 0.05$ ). In other words, learning biology using the Mnemonics technique has a positive effect on improving student learning outcomes in the system of biological classifications.

### 2. Memory (Retention) After Using Mnemonics Techniques

To determine the effect of retention (memory) of the application of the Mnemonics technique on improving student learning outcomes in the system of biological classifications, the data analysis was continued by testing whether there was a difference in the average scores on the initial and delayed tests, the results presented in [Table 3](#).

**Table 3**

Test Results in Average Difference between Initial Test Score and Delayed Test

Test	Average score	SD	t	Sig	Results
Initial	48.50	14.98	3.759	0.001	Reject Ho
Immediate	61.67	18.91			

From **Table 3** it is found that the average results before using the Mnemonics technique, and the average post-delayed test (given after two weeks after giving the immediate final test) were 48.50 and 61.67. There was an increase in the average score of learning outcomes of 13.17. It can be concluded that there is a significant difference between the average score of learning outcomes on the pre-test and post-delayed test (sig:  $p < 0.05$ ). Mnemonics affect the memory (retention) of students on the System of biological classifications material.

### 3. Retention Rate After Use of Mnemonic Techniques

To analyze students' memory (level) individually and classically, the data were analyzed using the formula: Retention (R) = (Average score of Post-Delayed Test)/(Mean Score of Immediate Final Test) x 100 %. The result of level analysis (category) students' memory after being involved in learning biology on the System of biological classifications using the Mnemonics technique individually and classically is presented in **Table 4**

**Table 4**

Results of Individual and Classical Retention Analysis

No.	Students code	Delayed test score	Immediate test score	R (%)	Category/results
1	A	65	80	81.25%	High
2	B	45	60	75.00%	High
3	C	85	80	106.25%	High
4	D	85	90	94.44%	High
5	E	40	70	57.14%	Low
6	F	45	75	53.33%	Low
7	G	50	65	76.92%	High
8	H	80	90	88.88%	High
9	I	60	65	92.30%	High
10	J	80	90	88.88%	High
11	K	45	65	69.23%	Medium
12	L	35	70	50.00%	Low
13	M	40	55	72.72%	High
14	N	95	95	100.00%	High
15	O	85	90	94.44%	High
16	P	100	100	100.00%	High
17	Q	65	70	92.85%	High
18	R	50	75	66.67%	Medium
19	S	35	60	58.33%	Low
20	T	60	50	120.00%	High
21	U	70	75	93.33%	High
22	V	55	65	84.62%	High
23	W	40	50	80.00%	High
24	X	55	65	84.62%	High
25	Y	45	50	90.00%	High
26	Z	70	75	93.33%	High
27	AA	70	80	87.5%	High
28	AB	60	65	92.31%	High
29	AC	90	90	100.00%	High
30	AD	50	65	76.92%	High
Average (classical)		61.67	72.50	85.06	High

Based on **Table 4** it was found that the level of memory (retention) involved in Biology learning using classical mnemonics was 85.06% (high). Individually, it was found that 24 (24/30%) students experienced high retention, 2 (2/30%) students experienced moderate retention, and 4 (4/30%) students experienced low retention.

This study found that learning using the Mnemonics technique had a positive effect on improving student learning outcomes and growing memory (retention) of seventh-grade students of the school in Biology class on the System of Biological Classifications.

The findings of this study were in line with the findings of several previous studies. Hardi's research (2008) concluded that the mnemonics method in the experimental group was more effective in improving memory ability than the control group that did not use mnemonics (conventional) methods. The research of Kurniawan and Nugrahalia (2014) concluded that the use of mnemonics methods can improve students' memory in biology subjects on the subject matter of the plant world (Plantae). Azmi, Najmi, & Rouyan's (2016) research in Malaysia concluded that the mnemonics method was effective in increasing English vocabulary in elementary schools.

The use of mnemonics techniques in this study is one form of teacher learning strategy that can affect student learning outcomes. Learning strategies applied by teachers in schools were external factors that affect students' interests, motivation, and learning outcomes (Slameto, 2003; Djaali, 2003). High interest and motivation in learning will have a positive effect on improving learning outcomes. This meant that students who have good interest and motivation in learning would lead to good learning outcomes. Haussler, et.al.(1998) asserted: "Pupils will learn a subject matter better at school if they are interested in it". Student learning outcomes were also influenced by their ability to remember information or knowledge they have learned in the past.

According to Uno and Umar (2014), mnemonics have a close relationship with memory ability because mnemonics work according to how the brain works. Working memory was several items that can be remembered by someone in a certain time, limitedly. Memory in the human brain was a pattern of communication between neurons. When a new memory is acquired, its encoding could involve thousands of neutrons scattered throughout the cortex. However, if the new information was not used, the newly formed connection pattern would soon disappear. On the other hand, if we remember it over and over again, the connection pattern would be more firmly formed in the brain network. Difficulty in recalling information that has been remembered because the information is not stored and maintained properly. A person's ability to retain memory depends on the technique and the ability itself (Eggen and Kauchak, 2012).

According to Djudin, T. & Amir R (2018), remembering was the act of storing things that have been known to be removed and reused at another time. Without memory, it was almost impossible for someone to learn something. Abu Ahmadi (1992) stated that memory (retention) was the power of the mind (brain) to receive information, store it for a certain time, and reproduce the information. Apart from using mnemonics techniques, students' retention (retention) of mastery of teaching materials can be grown and improved by using other techniques or strategies. Djudin (2019) applied a pictorial analogy technique to increase knowledge retention in factual, conceptual, and procedural dimensions after studying the topic of unidirectional electricity at the high school level. Djudin & Amir (2018) applied the technique of making two-dimensional final notes (graphic post organizers) which are integrated with the SQ4R reading technique, viz Survey, Question, Read, Recite, Review, and Reflect. Their research concluded that training students to make their final notes (after reading the reading text) in the form of graphic post organizers could improve the retention of concept mastery for second graders at the junior high school level on Earth and Space.

The delayed test in this study was carried out at an interval of two weeks after the immediate posttest. The determination of the interval or 2 weeks of gap time refers to previous research (Bendall & Galili, 1992; Djudin, 2018). Atkinson (1983), interval problems can be distinguished by the length of the interval and the content of the interval. The length of the interval was related to the length of time for entering the material (the act of remembering). The length of the interval is related to the strength (power) of retention. The longer the interval, the less strong the retention, or in other words the strength of the retention decreases. The content of the interval relates to the activities that exist or fill the interval. Activities that fill the interval would damage or interfere with memory traces, so individuals may experience forgetfulness. The length of the interval and the content of this interval were the basis of theories regarding forgetfulness. Therefore, to involve students in the learning process using mnemonics, it was necessary to organize teaching and learning activities that were systematic and clear (Hoyt & Winn, 2004).

During the treatment in this study, the majority of students stated that the use of mnemonic techniques was fun, and useful, and made it easier to remember the teaching materials presented in the

lesson. The use of the mnemonics method in the System of Biological Classification material in this study was expected to motivate other researchers and teachers to use and modify it further according to the characteristics of teaching materials, students, and school situations (classrooms) to improve students' understanding and retention.

## CONCLUSION

Based on the results of data analysis, this study concluded that the use of mnemonics methods affects improving student learning outcomes and memory on the material System of Biological Classifications of the seventh-grade students. To increase interest, motivation, learning outcomes, and retention, Science-Biology teachers need to apply mnemonic techniques in a varied and sustainable manner to make them more useful and according to the content of the teaching, material to be taught. The introduction and understanding of mnemonic techniques can be pursued through activities related to the professional development of teachers in schools.

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## REFERENCES

- Ahmadi, A. (2009). *Psikologi umum*. Jakarta: Rineka Cipta.
- Amiryousefi. (2011). Mnemonic instruction: A way to boost vocabulary learning and recall. *Journal of Language Teaching and Research*, 2(1), 178-182. <https://www.academypublication.com/issues/past/jltr/vol02/01/23.pdf>
- Arslan, M. (2006). The Influence of Teaching Note-Taking and Information Mapping on Learning and Recalling in Science. *Turkish Online Journal of Educational Technology-TOJET*, 5(2), 56-63.
- A.S. Hornby, et.al. (1987). *The advanced learner's dictionary of current English*. London: Oxford University Press.
- Atkinson, R. (1983). *Pengantar Psikologi*. Alih Bahasa: Nurdjannah Taufik. Jakarta: Earlangga.
- Azmi, M. N. L., Najmi, M. H. S. M., & Rouyan, N. M. (2016). A case study on the effects of mnemonics on English vocabulary. *International Journal of Applied Linguistics and English Literature*, 5(7), 178-185. <https://doi.org/10.7575/aiac.ijalel.v.5n.7p.178>
- Bakken, J. P., & Simpson, C. G. (2011). Mnemonic strategies: Success for the young-adult learner. *The Journal of Human Resource and Adult Learning*, 7(2), 79. <http://www.hraljournal.com/Page/9%20Cynthia%20G.%20Simpson.pdf>
- Bendall, S. Goldberg, F & Galili, I. (1992). Prospective Elementary Teachers' Prior Knowledge about Light. *Journal of Research in Science Teaching*, 30 (9), 1169-1187. <https://onlinelibrary.wiley.com/doi/abs/10.1002/>
- Depdiknas. (2013). Peraturan mentri pendidikan dan kebudayaan Republik Indonesia nomor 81A tahun 2013, tentang implementasi kurikulum. Jakarta: Depdiknas.
- Djaali. (2003). *Psikologi Pendidikan*. Jakarta: Bumi Aksara.
- Djamarah, S.B. (2006). *Strategi belajar mengajar*. Jakarta: Rineka Cipta.
- Djudin, T. & Amir R. (2018). Integrating SQ4R technique with graphic post organizers in the science learning of earth and space. *Jurnal Pendidikan IPA Indonesia*, 7(1), 76-84. <https://doi.org/10.15294/jpii.v7i1.11581>
- Djudin, T. & Grapragasem, S. (2019) The Use of pictorial analogy to increase students achievement and its retention of physics lessons of direct current. *Jurnal Penelitian Fisika dan Aplikasinya*, 9(2), 140-151. <https://doi.org/10.26740/jpfa.v9n2.p140-151>
- Eggen dan Kuachak. (2014). *Strategi dan Model Pembelajaran*: Jakarta: Indeks.
- Emalia, E., Juanengsih, N., & Siregar, S. H. (2019). Pengaruh model pembelajaran guided discovery berbantu strategi mnemonik terhadap pemahaman konsep sistem gerak. *Jurnal Pendidikan Biologi*, 12(2), 138-146. <https://dx.doi.org/10.20961/bioedukasi-uns.v12i2.29806>
- Habsari, A. M., Karyanto, P., & Probosari, R. M. (2012). Hubungan antara kemampuan memori dan motivasi belajar biologi dengan hasil belajar biologi ranah kognitif siswa SMA negeri 2 Madiun tahun pelajaran 2011/2012. *Jurnal Pendidikan Biologi*, 4(1), 89-96.

<https://jurnal.uns.ac.id/bio/article/view/5546>

- Hardi. (2008). Efektivitas metode mnemonics untuk meningkatkan kemampuan mengingat lambang unsur-unsur kimia fakultas psikologi universitas Sumatera Utara. [Skripsi]. <http://repository.usu.ac.id/handle/123456789/23372>
- Häussler, P., Hoffman, L., Langeheine, R., Rost, J., & Sievers, K. (1998). A typology of students' interest in physics and the distribution of gender and age within each type. *International Journal of Science Education*, 20(2), 223-238. <https://doi.org/10.1080/0950069980200207>
- Hoyt, J. E., & Winn, B. A. (2004). Understanding retention and college student bodies: Differences between drop-outs, stop-outs, opt-outs, and transfer-outs. *NASPA journal*, 41(3), 395-417. <https://www.tandfonline.com/doi/abs/10.2202/1949-6605.1351>
- Joyce & Weil. (1987). Model of teaching edisi kedelapan. Penerjemah: Ahcmad Fawaid da Ateilla Mirza. Krakow: Scientiae er Didactics.
- Kurniawan, A., & Nugrahalia, M. (2014). Efektivitas strategi mnemonik terhadap hasil belajar siswa pada materi pokok dunia tumbuhan (plantae) kelas XSMA R.A. Kartini Sei Rampah tahun pembelajaran 2013/2014 [Skripsi]. <http://digilib.unimed.ac.id/4814/>
- Lestari. (2010). Metode mnemonik untuk mengingat dua belas nervus cranialis pada mahasiswa tingkat II Akper Kosgoro Mojokerto. *Jurnal Pendidikan*. 2(4): 75-89. <https://core.ac.uk/reader/12348475>
- Lubin, J., & Polloway, E. A. (2016). Mnemonic instruction in science and social studies for students with learning problems: a review. *Learning disabilities: A contemporary Journal*, 14(2), 207-224. <https://files.eric.ed.gov/fulltext/EJ1118431.pdf>
- Manalo, E. (2002). Uses of mnemonics in educational settings: A brief review of selected research. *Psychologis Journal*, 45(2), 69-79. <https://doi.org/10.2117/psysoc.2002.69>
- Mocko, M., Lesser, L. M., Wagler, A. E., & Francis, W. S. (2017). Assessing effectiveness of mnemonics for tertiary students in a hybrid introductory statistics course. *Journal of Statistics Education*, 25(1), 78-91. <https://doi.org/10.1080/10691898.2017.1294879>
- Putnam, A. L. (2015). Mnemonics in education: Current research and applications. *Translational Issues in Psychological Science*, 1(2), 130. <https://doi.org/10.1037/tps0000023>
- Ramachandran, S. D., & Rahim, H. A. (2004). Meaning recall and retention: The impact of the translation method on elementary level learners' vocabulary learning. *RELC journal*, 35(2), 161-178. <https://doi.org/10.1177/003368820403500205>
- Rahman, T. (2002). Peranan pertanyaan terhadap kekuatan retensi dalam pembelajaran sains pada siswa SMU. *Jurnal Pendidikan dan Budaya*, 1(2), 37-36. <http://jurnal.fkip.unla.ac.id/index.php/educare/article/view/12>
- Setiawan, A., Sutarto, Indrawati. (2012). Metode Praktikum dalam Pembelajaran Pengantar Fisika SMA: Studi Pada Konsep Besaran dan Satuan Tahun Ajaran 2012-2013. *Jurnal Pembelajaran Fisika*, 1(3), 3-8. <http://repository.unej.ac.id/xmlui/handle/123456789/11820>
- Slameto. (2003). Belajar dan faktor-faktor yang mempengaruhinya. Jakarta: Rineka Cipta.
- Siberman & Auerbach. (2013). *Active training: Pedoman praktis teknik, desain, contoh kasus, dan kiat*. Penerjemah oleh M. Khozim. Bandung: Nusa Media.
- Siregar, & Nara. (2015). *Teori belajar dan pembelajaran*. Bogor: Ghalia Indonesia.
- Sugiyono. (2016). *Metode penelitian pendidikan*. Bandung: Alfabeta.
- Syah, M. (2010). *Psikologi Pendidikan Dengan Pendekatan Baru*. Bandung: PT. Remaja Rosdakarya.
- Uno., & Umar. (2014). *Mengola kecerdasan dalam pembelajaran: sebuah konsep pembelajaran berbasis kecerdasan*. Jakarta: Bumi Aksara.