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Research Article

The Effect of Using Visual Mnemonics on Long-term Memory Retention for Subject of History

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Abstract

The challenge of history is the method of teaching and learning, and the prevalence of teachers using lectures or various lecture methods. Developing student ability mastery in this subject is one of the major challenges faced by the teachers. Therefore, this study aims to examine the effect of visual mnemonic developed based on imagery techniques that is the integration of keywords with images or objects on the retention of long-term memory for the subject of History form one. The study was conducted experimentally with one group. A total of 24 students were involved in this study. A pre-posttest was performed for comparison and the next test was a comparison of three different time intervals over a period of weeks. Data were analyzed using a t-test and ANOVA Test. The results showed that there was a significant difference in scores between pre and post-tests. However, the retention test showed no significant difference in score for the three different times. Visual mnemonics show a good effect on long-term memory. The results of this study can be used as a method of teaching and learning, especially for factual subjects.

Keywords: visual mnemonic, retention of long-term memory, history subject

INTRODUCTION

Cognitive load can be associated with four types of memory: sensory, short-term, working, and long-term. These four types of memory function differently. Sensory memory refers to very brief memory, compared to short-term memory. Working memory is the brain's ability to store information and aid in processing thoughts, while long-term memory encompasses memories that span from several days to several decades. In the process of learning, information needs to move from sensory memory to

long-term memory. According to Mayer (2014), and Moreno and Mayer (2007), sensory memory and working memory have very limited capacities in processing information, so their use needs to be optimized. The use of visual and verbal elements can facilitate the integration of new information. Therefore, the use of multimedia elements can enhance learning and aid in storing information in long-term memory. Due to the limited capacity of working memory, students need to be selective in choosing information from sensory memory that requires attention during the learning process. Hence, the production of teaching materials has significant implications for the teaching and learning process.

Paas and Ayres (2014) discussed the Cognitive Load Theory, which emphasizes the management of working memory load. Working memory is the ability to store various information and reproduce it. However, the capacity to remember something is limited to about seven pieces of information at a time. To strengthen working memory, an appropriate method is needed to assist individuals in enhancing their memory recall. This theory states that an individual's short-term memory can process a limited number of elements simultaneously (Nurkhamimi et al., 2021). According to this theory, working memory can process information if i) long-term memory can store knowledge and skills permanently or temporarily, and ii) it also functions as an intellectual tool (Maizan, 2017). Therefore, one way to optimize working memory load is through instructional design (Yusniza, et al., 2017). Good instructional design can help improve working memory capacity so that information can be retained in a person's mind, enabling better retention of their thoughts. Previous studies have shown that one of the techniques used is the mnemonic technique (Ahour & Berenji, 2015).

Mnemonics are techniques used by individuals to aid in remembering something. In other words, these techniques help encode and recall important information in memory. They are usually associated with the use of images, synonymous phrases, or words. Mnemonic techniques can be varied, such as visual, audio, or textual, which have an impact on memory (Abdalla et al., 2021). Mnemonic techniques include various methods like keywords, passwords, loci, music mnemonics, name mnemonics, phrases or words, models, poems, organizational notes, images, associations, and spellings (Maghy, 2015). All these mnemonic techniques are used based on the suitability of students' learning levels and ages. For example, teaching the alphabet to children is more suitable using mnemonic music techniques because children find it more enjoyable to learn. Additionally, to remember extensive vocabulary, the keyword mnemonic technique, such as in Chinese vocabulary (Rawendy et al., 2017), can be helpful.

Digital mnemonics, like E-flashcards (Li & Tong, 2019), have shown positive effects in using multimedia audio applications for recognizing Chinese words among non-native speakers. Learning in languages related to mnemonics, such as English (Maysoon & Mohammed, 2017), Chinese (Rawendy et al., 2017), vocabulary (Ahmadi et al., 2020; Ahour, Berenji, 2015; Koksal & Cekic, 2014; Ghoneim & Elghotmy, 2016), English alphabets (Maysoon et al., 2017), and Japanese (Rasiban et al., 2019), can help students remember better. Mnemonic techniques are not limited to languages; they are also used in Mathematics and Science. In mathematics, mnemonic techniques are used in differentiation and integration (Yahya, et al, 2017), trigonometry (Malis et al., 2016), algebra (Salleh & Zakaria, 2011), and general mathematics (Maghy, 2015). Medical studies (Cole et al., 2021; Ward, 2019; Jones & Guinea, 2017; Fernandes & Speer, 2002) and fields like accounting (Rodzi, et al., 2021; Abd Rahim,

2018; Laing, 2020), business (Wailoo & John, 2013), and economics (Yin, 2012) also utilize mnemonic techniques. Wang and Thomas (1996) reported that mnemonic techniques are more commonly used by gifted students compared to regular students, indicating their support for teaching and learning.

Hill's study (2022) demonstrated that mnemonic techniques can improve retention and recall of English as a second language (Maysoon et al., 2017; Zarei & Keyson, 2016; Ghoniem & Elghotmy, 2016). The effective use of mnemonic techniques includes the keyword technique, as shown in studies by Ahmadi et al. (2020), Rawendy et al. (2017), Maysoon et al., (2017), and Li & Tong (2019). Zarei and Keysan (2016) reported similar findings, as did Koksal and Cekic (2014). Empirical studies have found that visual mnemonics can aid sensory memory, especially in visual aspects, strengthening the imaginative brain. Supporting visual learning as input significantly affects recognition, differentiation, and memorization, especially in language learning (Chen et al., 2013, Shen 2010). Shen (2010) stated that using both verbal and visual coding is more effective than using only one. Ahmadi and Zarei (2021) also indicated that linguistic, visual, and verbal mnemonics influence teaching and learning.

This study suggests using visual mnemonic instructional materials to aid long-term memory in storing information longer and more permanently in students' minds, as depicted in Figure 1. Visual mnemonics in instructional materials enter sensory memories, such as visual and auditory senses, which quickly fade from this memory. Some of this information is transferred to working memory for thinking and further processing purposes. In working memory, the mind constructs a model known as a verbal model and an image model and connects both models to form relevant knowledge. Consequently, suitable knowledge is built for long-term memory (Mayer, 2014; Moreno & Mayer, 2007). Long-term memory has a large capacity; it needs to be manipulated to store many facts at once. Although individuals have different memory capacities, they should be utilized optimally. The primary process of remembering something is closely related to the brain's image function, and consistent studies have shown that the effect of images strongly influences a person's long-term memory. Generally, this process occurs in mnemonic processes related to how information is received, stored in sensory memory, then in working memory, and finally retained in long-term memory.

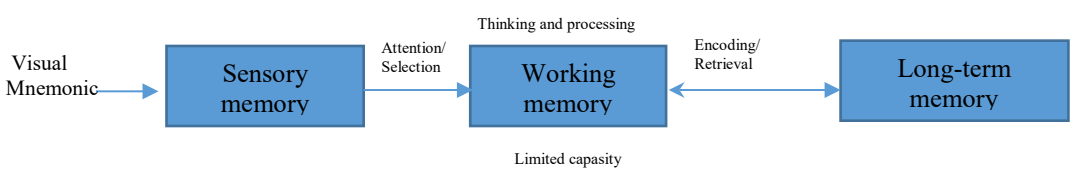

Figure 1: Adaption from Mayer (2014) and Moreno & Mayer (2007)

Previous studies that have been reviewed found that many focused on language and mathematics aspects, but there is still a lack of research conducted on subjects that involve a lot of facts, such as history, geography, biology, and others. Most students perceive subjects that are filled with facts as difficult and require a lot of memorization. Therefore, to what extent can visual mnemonic techniques be used as a tool to aid in retaining memory when remembering numerous facts and long sentences?

One of the main challenges faced in the teaching and learning of history subjects is related to the abundance of facts and historical events (Kiamsin & Talin, 2018). Teacher delivery methods, which often lean towards lecturing (Sharipah & Arba'iyah, 2016), are also known as teacher-centred learning. This method lacks innovation and creativity, being unidirectional and rather monotonous; thus, it is less appealing (Kiamsin & Talin, 2018). Additionally, it heavily relies on the use of textbooks alone. Dependence on existing materials often leads to students confusing facts. According to Sharipah & Arba'iyah (2016), this results in unsatisfactory student performance in examinations, be it at the Sijil Pelajaran Malaysia (SPM) or Sijil Tinggi Pelajaran Malaysia (STPM) level. In history education, other challenges include the need to remember a multitude of facts, difficulty in constructing sentences, undeveloped mental processes (associating facts and numbers), mental fatigue, misconceptions, and the imperfection of various types of thinking. Teaching strategies are limited, leading to boredom, among other issues. If teaching methods that do not stimulate memory are used by teachers in history education, the knowledge imparted by the teacher will pass by without meaning to the students. Therefore, this study aims to investigate how the use of visual mnemonics can assist in retaining information in both short-term and long-term memory in history subjects.

PROBLEM STATEMENT

Nor Azan et al (2009) stated that students become bored and less interested in History subjects because there is a lack of creativity in teaching and learning. According to Anuar and Nelson (2017), teachers need to be more creative in planning lessons and adapt to students' abilities for teaching and learning History subjects. Suo Yan Mei et al. (2018) found that the use of Quizziz in Arabic language classes contributed to a high percentage of positive outcomes and stated that using Quizziz as a teaching tool can capture students' interest and help them focus better during the teaching and learning process. Anuar and Nelson (2017) mentioned that teaching methods using conventional and traditional techniques, as well as the "chalk and talk" approach, are less suitable for the needs of students in the 21st century. Rajendra and Sudana (2018) found that the experimental group undergoing learning processes using interactive multimedia technology achieved higher scores compared to the control group undergoing learning processes using conventional techniques.

According to John et al (2014), poor information storage performance occurs because the amount of information entering exceeds the capacity of working memory. This can lead to cognitive overload. This cognitive load causes students to have difficulty remembering a large amount of information at once. In this regard, Fatemeh and Naser (2015) stated that based on previous studies, mnemonic techniques are effective methods to use in learning situations where memorization is necessary. Fatemeh and Naser (2015) conducted a study comparing the effectiveness of using mnemonic and non-mnemonic techniques in foreign language learning. The study results showed that using mnemonics in foreign language learning is more effective and efficient compared to using non-mnemonic methods.

LITERATURE REVIEW

Zahra et al. (2019) stated that mnemonics are described as memory aids or tools that help students remember information. The term "mnemonic" originates from the Greek word "Mnemosyne,"

referring to the ancient Greek goddess of memory. Mnemonics are described as techniques or memory-enhancing devices that assist in information processing, including storage and recall (Amiryousefi and Ketabi, 2011, as cited in Zahra et al., 2019). Additionally, mnemonics are described as easier retrieval cues for memory recall (Bakken and Simpson, 2011, as cited in Zahra et al., 2019). Moreover, Zahra et al. (2019) stated that mnemonics involve combining new information with old information using images, words, letters, and their combinations.

Ali and Mohammad (2016) conducted a study using the keyword mnemonic technique, which helps students remember vocabulary for a long period. Nur Sa'adah (2017) mentioned that the acronym mnemonic technique greatly aids in remembering vocabulary for an extended period. Marjan and Farzin (2015) stated that mnemonic techniques are also used to remember English verbs. Mnemonic techniques like keywords, loci, and images, incorporated into gamification, help students remember the Chinese language effectively (Rawendy et al., 2017). Michelle et al. (2016) stated that information and learning presented visually have higher permanence and are stored in long-term memory. Enamul (2018) mentioned that memorization is not just about 'rote learning' but can be done using various techniques such as mnemonics, visualization, memorization learning, and so on.

METHODOLOGY

This study was conducted to identify the effects of visual mnemonic techniques on short-term and long-term memory using a quasi-experimental method with a pre-post test design for a single group. The pre-test and post-test were based on Chapter 1 of the 4th-grade history textbook, specifically the topic of Civilization Advancement. A total of 24 participants were involved, consisting of 4th-grade students from a school in Negeri Sembilan. The sample size for this study was deemed appropriate; according to McMillan and Schumacher (2010) and Cresswell (2008), the minimum sample size for quantitative experimental research is 15 individuals. The study was conducted in two phases: the first phase measured the learning effects using visual mnemonic techniques, and the second phase measured the retention of information in memory. Table 1 illustrates the procedures carried out during the first phase of this study.

Table 1: Implementation method for pre-test and post-test/ post_1 test

Group	Pre-test	Approach	Post-test/ Post_1 test
Treatment	O_1	x	O_2

For the second phase, as shown in Table 2, the retention test was conducted over a period of 14 days (Rohrer & Pashler, 2007; Hayne, 1990). This 14-day interval was introduced after the post-test to ensure that there were no memory effects from the previous post-test questions. The purpose was to observe the long-term memory retention of students, as studied by Rohrer and Pashler (2007) and Hayne (1990). In the first phase of the study, 24 students were initially involved; however, only 21 students participated in the second phase. Three (3) students were excluded due to their inability to commit throughout the study.

Table 2: Implementation method for long-term memory retention test

Group	Post-test/ Post_1 test	Post-test 2	Post-test 3
Treatment	O_2	O_3	O_4

The experimental study procedure is summarized in Figure 2. The research instruments consisted of one set of pre-test questions and three sets of post-test questions. Achievement tests were utilized to measure an individual's knowledge of a particular subject (Noraini, 2010). This was done to assess the impact of learning using visual mnemonic techniques. The research instruments were sourced from trial examination question banks for the Sijil Pelajaran Malaysia examinations and were verified by the subject head of the history department. Participants were given a 20-minute time limit to answer the questions. Table 3 illustrates the distribution of marks based on the question types.

Table 3: Distribution of questions for pre-test and post-test

Type of questions	No. Questions	Marks
Objective (Part A)	10	20
Structure (Part B)	2	20
Total		**40**

The pre-test and post-test scores were analyzed using descriptive statistics, t-tests, and one-way ANOVA. Several assumptions needed to be met before conducting t-tests and one-way ANOVA. These assumptions included the independence of test scores, normal distribution, and homogeneity of variances (Mann, 2004).

RESULTS AND DISCUSSION

The data were analyzed using Statistical Program for the Social Sciences (SPSS) Version 28.0. The discussion began with descriptive statistics, followed by t-tests and one-way ANOVA. Table 4 displays the pre-test and post-test scores for the 24 respondents involved in this study. The pre-test scores ranged from 2 to 16, while the post-test scores ranged from 2 to 18. The post-test scores were higher, and the lowest scores remained the same.

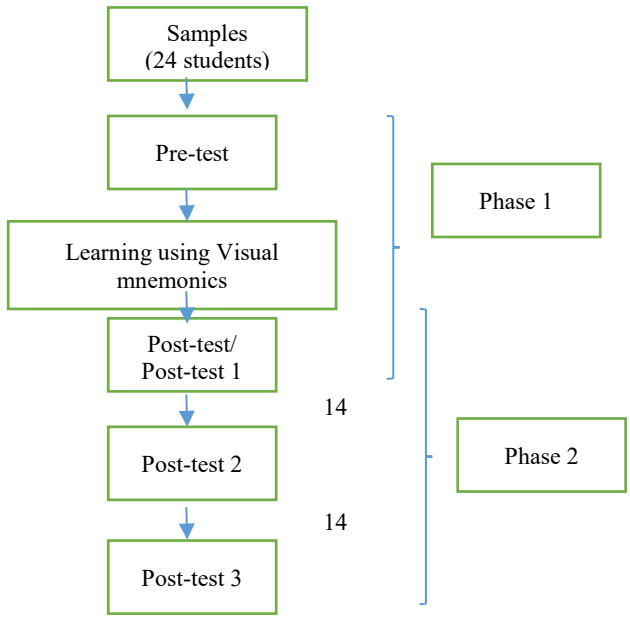

Figure 2: Flow chart of the experimental study procedure

Table 4: Pre-test and post-test scores

Respondent	Pre-test	Post-test/ Post_1 test	Respondent	Pre-Test	Post-test/ Post_1 test
P1	10	9	P13	13	16
P2	11	16	P14	16	17
P3	6	15	P15	7	6
P4	11	17	P16	5	5
P5	7	12	P17	2	2
P6	5	18	P18	5	6
P7	5	13	P19	8	8
P8	4	17	P20	10	9
P9	6	13	P21	11	12
P10	10	15	P22	11	5
P11	12	16	P23	14	10
P12	6	13	P24	6	12

The results of the descriptive analysis, minimum, and standard deviation of pre-test and post-test exam scores are shown in Table 5. The minimum score for the pre-test is 8.38 (SD=3.56), and the minimum score for the post-test is 11.54 (SD=4.82). The increase in the minimum score for the post-test indicates that the use of the technique had a positive impact on the respondents' exam scores.

Table 5: Descriptive analysis

	N	Minimum	Maximum	Min	Standard Division (SD)
Pre-test	24	2.00	16.00	8.38	3.56
Post-test	24	2.00	18.00	11.54	4.82

Table 6 shows that the paired t-test conducted to assess the effect on the dependent variable indicates a significant difference. Based on the t-test, there exists a significant difference $t(23) = -3.157$, $p = .002$, meaning the p-value is less than .05.

Table 6: Paired t-test Analysis for Pre-test and Post-test Exam Scores

Test	t	df	Sig. p
Pre-post test	-3.16	23	.002

*Significant at level p<.05

A One-Way ANOVA was conducted to test the effect of visual mnemonics on retention in the long-term memory of the respondents. The F-test $(2, 63) = 0.352$ with a p-value of 0.705, where $p > .05$. This indicates that there is no significant difference in scores between different time intervals of repeated tests - Post Test_1, Post Test_2, and Post Test_3, as shown in Table 7. Based on these findings, the scores obtained are consistent over a span of 4 weeks, indicating a positive effect. This suggests that the use of visual mnemonics aids in retaining information in long-term memory for learning history subjects.

Table 7: One-way ANOVA test results

Source	Sum of Squares	df	Mean Square	F	Sig.
Approach	8000.41	1	8000.41	382.69	<.001
Time intervals	14.71	2	7.35	.35	.71
Errors	1317.05	63	20.906		
Total	9406.00	66			
Total Corrected	1331.758	65			

*Significant at level p<.05

CONCLUSION

This study was conducted during the Covid-19 pandemic. One of the weaknesses of this study is the lack of comparison between the control and treatment groups due to the constraints of the Standard of Procedure (SOP) that needed to be adhered to. This resulted in a limited number and movement of students during the study. Nevertheless, the study results indicate that the implemented visual

mnemonic technique had a positive effect on academic achievement in the subject of history, both before and after the intervention. Although the students' achievement was not significantly high, the stimulation obtained from visual mnemonics made working memory in the mind easier, meaning cognitive load could be reduced. This supports the model used, an adaptation from Mayer (2014) and Moreno and Mayer (2007).

The study results regarding visual mnemonics on long-term memory showed no significant difference between the 14-day and 28-day intervals. This study indicates that visual mnemonics do not impact long-term memory, meaning the information stored in long-term memory remains stable. Based on the Cognitive Multimedia Theory Model by Mayer as shown in Figure 1, human memory is divided into three parts: sensory memory, working memory, and long-term memory. Through this study, it can be seen that the effect of retaining information in students' minds shows that visual mnemonics can help information retained in the mind last longer in memory, making information processing more efficient at the long-term memory stage (Hill, 2022; Rawendy et al., 2017; Anhour & Berenji, 2015). However, in the retention study, null effects and size were not investigated. Additionally, some respondents were dropped from the study due to its relatively long duration. Information processing involving the integration of existing knowledge and newly acquired knowledge visually received can build new knowledge that remains in long-term memory. This is consistent with a study conducted by Zarei and Salimi (2012), which stated that keyword techniques are more effective than pictures and songs.

In conclusion, visual mnemonic techniques can be used as teaching aids to enhance students' achievement and retention in long-term memory for history subjects. This suggests that this mnemonic technique is not only suitable for history subjects but also for subjects that involve memorization and require a high cognitive load, such as geography, languages, Islamic education, and moral education. However, further research could explore multimedia elements such as animations and gestures.

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CONFLICTS OF INTEREST

The authors declare no conflicts of interest.

DECLARATION OF GENERATIVE AI

The authors declare that no generative AI was used in the writing of the manuscript.

DATA AVAILABILITY STATEMENT

Data available within the article or its supplementary materials.

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