Effects of new Mnemonic - CAMR together with the inquiry learning cycle model in biology classes of senior high school students in Thailand

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Abstract: *The study employed the new Mnemonic - CAMR together with the inquiry learning cycle as a developing model. The participants of an experiment group and a control group were selected using the cluster random sampling technique. The research instruments were a lesson plan using this new strategy, a lesson plan using only the inquiry learning cycle, a learning achievement test, and a working memory test. The data were analyzed by using a t-test for an independent sample. The finding showed that the learning retention and the experiment group's working memory were higher than the control group at the .05 levels of significance. Moreover, the effects of this new potential strategy were discussed. Thus, the model is suitable for the biology teachers in the teaching and learning process of biodiversity topics, while the students can utilize this model to improve their understanding of the topic and enhance learning retention and working memory.*

Keywords: Mnemonic strategy, Inquiry learning cycle, Working memory, Learning retention

Introduction

Science is very significant in modern times, and they play a greater role in the future, especially in biology, because of its importance in human life and very close to us (Rull, 2014; Ibe & Abamuche, 2019). Therefore, each country is trying to develop or create people with scientific knowledge. However, children from poorer backgrounds are disadvantaged in developing countries are disadvantaged concerning their learning development (Zorn & Noga, 2004; Kamper & Mampuru, 2007; Hamble & Dixon, 2017). Therefore, the researchers would like to find a simple strategy and not costly to promote science teaching and can be applied to each context of the child to achieve more educational equality. Moreover, based on the interview results with science teachers about the problems in the classes (Urdiales-Ibarra et al., 2018), it is considered the lack of student persistence, especially in learning biology. They can remember content for a short time and have no skills in memorizing content knowledge. These may be due to teaching and learning management that is still unable to develop students to learn and understand the link contents.

Most problems of biology classes were caused by scientific terminology (Mandell, 1975). Especially the content of biodiversity which have many specialized scientific terminology. These give students trouble remembering biology vocabulary and understand content, which is the basic knowledge that students must have. If the learners can not remember these basic content, they will have insufficient knowledge to use in analytical thinking, applying or studying in the future causing the development of memory which is the first knowledge base. Moreover, the results of interviewing 10th grade students who learned the biology course on biodiversity showed that they wanted the instructor to teach methods or techniques to remember, more than just teaching only content. As the saying goes, The nature of science is not merely memorization, it is a quest for knowledge, a collection of information, resulting from self-knowledge creation, and can be applied to everyday life. However, the emergence of new knowledge, scientific skills including the sequence of steps for various methods to search for knowledge of learners will not be able to happen at all if the learners are unable to recognize the content that is the basis of various processes (Khaemmanee, 2012).

Therefore, improving the quality of teaching and learning is essential in developing knowledge and the student's skills, as mentioned before by the appropriate learning management model. The famous model widely used for science courses is the inquiry learning cycle model (Bybee et al., 2006). BSCS (Biological Science Curriculum Study) educators have invented and implemented this inquiry-based approach to develop science courses. However, using only the inquiry learning model may not solve the duration of recognition, which will affect students' learning retention, and most of the usual biology content has many vocabularies to remember. So, it may not be enough to promote the memory skills of the students. Therefore, one crucial technique that plays a role in developing memory is mnemonic, which leads us to create the ultimate memory and pull out the maximum potential (Hancock, 2016). Mnemonic is a technique that allows children to remember information or vocabulary very well and easily, as well as being an unfamiliar data link caused by learning to be familiar with the previously known alphabet or pictures. Many researchers have adopted the mnemonic reconstruction strategies in teaching and learning, and this can help to remember and easier to restore data more meaningful and more concrete. These strategies are available for children of all ages and can be applied according to various types of content and a wide range of uses in high school children in memorizing words (Bakken & Simpson, 2011; Ketabi, 2011).

Then, memory skills are essential and should be developed first, and these are the essential skills for a brain that leads to a successful life or can be called EF (Executive Functions), which are essential skills and necessary for the future world that makes human living more efficient and successful (Best et al., 2011; Diamond, 2013). Humans are not born with EF skills but are born with the potential to develop these skills (Borai et al., 2020) and make EF skills more active in intelligence development. This development can lead learners to succeed in various fields, especially senior high school students. Therefore, they must also be able to develop their brain skills to their full potential. The basic skill that serves as the first step in brain skills to a successful life is working memory or skills for short-term memory that occurs while doing various activities. While working, this memory skill will help students remember better and collect information while studying, doing activities, or working (Huizinga et al., 2018; Borai et al., 2020). It should be

developed together with long-term memory, which will help encourage the students to have more permanent memory. In addition, this short-term memory can be embedded into long-term memory and enable the retrieval of data stored in long-term memory for using or more persistence in learning the students (Lo, 2018).

Consequently, the researchers synthesized the new potential technique called the "CAMR technique," which is a memorizing and a combination of inquiry learning cycle models to help solve the problems mentioned above. This will also help students improve their learning retention, working memory, more interest in studying, and not be costly to be a guideline for promoting classroom activities that emphasize innovation in science groups in the future.

Purpose of the Study

The research aims to study the effects of the new Mnemonic - CAMR together with the inquiry learning cycle to enhance senior high students' learning retention and working memory in Thailand.

Research Framework

Supporting theory for the development of the new Mnemonic - CAMR strategy

This new Mnemonic strategy is based on a number of theories and researchers and applied to create a suitable strategy with a reliable procedure (Pungsamrong et al., 2018). It is based on learning development, and it corresponds to theories and concepts in which knowledge and students' memory will be highly obtained. The detail is listed below:

1. Cognition is the first step that relies on distinguishing, acknowledging, and learning from experiences. According to Bloom's Taxonomy, knowledge and memory are the foundation of education. In addition, Piaget's Theory and Information processing theory mentions that absorbing new knowledge or experience is a way to receive input from the environment (Gurbin, 2015; Bormanaki & Khoshhal, 2017).

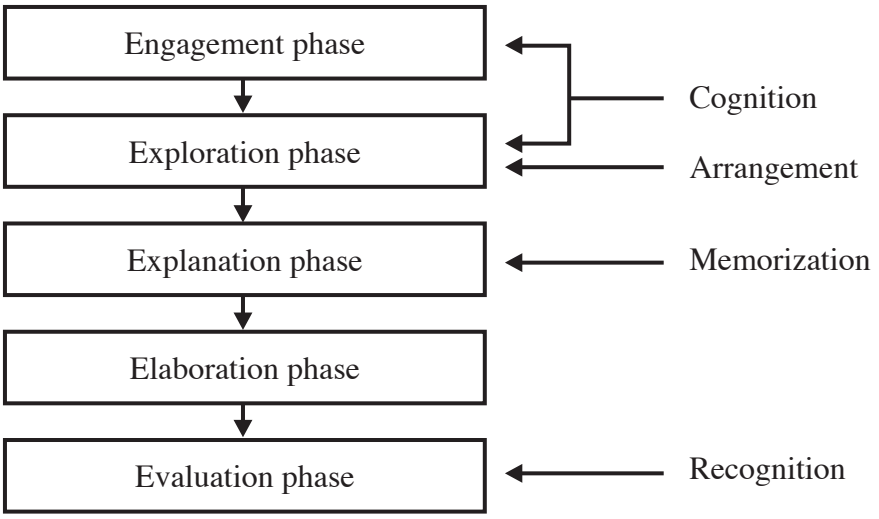
2. Arrangement is the most critical step that is based on various supporting theories. For example, information processing theory explains encoding in which data is kept in long-term memory (Gurbin, 2015). In Gagne's learning concept, the students will have to recall their existing knowledge to connect it with new knowledge and start to act on their own. This will help students express their actions associated with the objective (AL-Shammari et al., 2015). It is also linked to Ausubel's theory mentioning that a person who has a foundation to relate the knowledge that he/she already has with new knowledge makes it meaningful (Agra et al., 2019). Other than that, the arrangement procedure also corresponds to Bruner's theory in an iconic mode in which children can use pictures instead and in a symbolic mode in which symbols are used for learning. Students can understand the abstract by writing down the first underlined words (Wen, 2018). This is also accordant to George Herbert Mead's symbolic interaction (Redmond, 2015). Moreover, this step instructs students to be self-learners, and instructors are just surrounding providers, related to the constructivism theory (Adom et al., 2016). At the same time, Guilford's structure of intellect supports that the thinking dimension explains permanent memorization as long-term memory (Kurtzberg & Amabile, 2001). Students will use this for vocabulary distribution and selection of suitable syllables for creating a mnemonic sentence that

describes various forms of stimulus, such as symbol or language. It can be either meaningful language or words that students knew before to establish memorization.

3. Memorization is a step for practicing and memorizing the complete sentence by applying the law of exercise from the learning theory of Thorndike by making a firm connection with stimulus and correctly interacting from repeatedly practicing (Karadut, 2012). This will result in long-term and permanent learning. According to Information Processing Theory, repeated memorization can help store knowledge in long-term memory (Gurbin, 2015). Moreover, the equilibrium from Piaget's theory is applied to mix old and new ideas and create balance (Bormanaki & Khoshhal, 2017).

4. Recognition is the stimulus-response step. When seeing a word, sentence, or symbol that the students have known before, they will recognize using Information processing theory. Output restoration involves encoding memorized data from long-term memory and transferring it into response (Gurbin, 2015). In addition, as related to Guilford's Structure of Intellect, the content will make students determine their memorization in the form of visual, auditory, symbolic, semantic, and behavioral (Kurtzberg & Amabile, 2001). The students can create a context of the mnemonic sentence into a meaningful sentence. Moreover, behavior is also a stimulus that may involve individual interaction or social relations.

The new Mnemonic - CAMR strategy contained principle, detail, and related learning theories. Consequently, this memorization strategy is accurate, precise, and suitable for further application.



Picture 1 Determining the process of learning management through the inquiry learning cycle model (5Es) in combination with a new Mnemonic CAMR strategy.

Materials and Methods

1. Population and sample group

The population applied in this study was senior high school students, Who are about 16-17 years old and studying in the science program in Chonburi province of Thailand. which the school has divide the students into 3 classrooms. Total number of 135 people divided into 45 people per room. Every class was randomized with students

of various knowledge and skills levels. Sample groups were randomly chosen according to random cluster sampling. Two classes were selected randomly, one class as a control group, which was provided with the inquiry learning cycle model, and the second class as an experiment group, which was provided with the new Mnemonic - CAMR and inquiry learning cycle model. Finally, The researcher requested to collect the data by himself and this research project has passed the ethical review process of the Burapha University.

2. Research variables

There are two groups of variables in this research. First, The Independent variable is the new Mnemonic - CAMR together with the inquiry learning cycle in biodiversity class for senior high school students. Second, the dependent variables are learning retention and working memory. The new Mnemonic - CAMR strategy was re-invented and developed by researchers from an old mnemonic strategy, which possibly causes false memory from the original term and has no straightforward procedure explaining how to build a sentence be more efficient. The new Mnemonic - CAMR strategy emphasizes using the first syllable and original pronunciation to provide procedure, methodology, and strategy detail mentioned below.

2.1 Step 1 Cognition is learning knowledge from various sources; meaning, derivation, and basic understanding. This is collective learning in which a person can learn both directly and indirectly to understand the information characteristic that is needed to be remembered.

2.2 Step 2 Arrangement is organizing all information needed to be remembered into meaningful images and events. This arrangement step is divided into two patterns, including order arrangement and independent arrangement. The first or first two syllables of each required information are taken and arranged into a pleasurable order for an individual. After that, each main word is underlined to inform that those first or first two syllables are derived from which information. They are then distributed below and transformed into words with similar pronunciations. This distribution can be one or even two words. The pronunciation of those alphabets must not be excessively altered.

Next, the distributed words are extracted into a meaningful sentence. Other additive words can be given to complete this sentence, but the less, the better. One more thing to be concerned about is that each sentence should be imaginative or having some senses of humor, for example; Por (Porifera), Coe (Coelenterata), Plathy (Platyhelminthes), Anne (Annelida), Moll (Mollusca), Nema (Nematoda), Artho (Arthropoda), Echi (Echinodermata), Chor (Chordata)

Example of distributed words:

Example 1

Por	Coe	Platy	Anne	Moll	Nema	Artho	Echi	Chor
poo	si	party	any	moll	**Nema**	art	ex	chor
pore	**sy**	pati	anny	mont	Name	**artho**	eco	**core**
paul	sea	**pa**	**ani**	more	Nymph		**echi**	cho
por	see			**mal**			ec	

"Porsy pa ani mal nema" "Artho! echi ngub core"

Or Example 2

"Paul see party" "Ani mal and nymph's art echo"

2.3 Step 3 Memorization is a step of applying the arranged sentence above to memorize and familiarize it. First, students try to imagine pictures from those arranged words, such as people, situation, object, or action. Then, imagine the scene following the sentence and repeatedly memorize them together 3-4 times or until successfully remember. After completing the previous step, memorize the main words in the sentence and repeat the correct total words. For example, in example 1, we got two new mnemonics sentences, *"1. Porsy pa animal nema"* and *"2. Artho! echi ngub core"* which the researchers and our students created in Thai karaoke words mix with English words. Moreover, we added "ngub" to complete the first sentence. The meaning of these sentences was, "1. Porsy brings animals away. And 2. Oh, man! Who bites a neck?" In example 2, we got two new mnemonics sentences *"1. Paul see party."* and *"2. Animal and nymph's art echo."*

2.4 Step 4 Recognition is a step of restoring the memorized information used by self-testing with the memory of the correct name, characteristic, composition, or basic information of the data.

3. Research instruments

3.1 Lesson plans using the inquiry learning cycle

3.2 Lesson plans using new Mnemonic - CAMR together with inquiry learning cycle

3.3 Achievement test in biology classes containing 30 four-multiple-choice questions with difficulty at 0.23-0.65, discrimination at 0.23-0.69, and reliability at 0.89

3.4 Working memory test in Biology subject containing two types; Forward block-tapping span test with two essay questions and backward block-tapping span with two essay questions, difficulty at 0.51-0.67, discrimination 0.21-0.28, and reliability at 0.85

4. Ethical Consideration

The researcher requested to collect the data by himself after the research instruments was submitted the research ethics committee of Burapha university for formal approved the proposal.

5. Data collection and analysis

5.1 Researchers performed as lecturers in biodiversity using new Mnemonic - CAMR together with inquiry learning cycle as a treatment group or an experiment group and using only inquiry learning cycle as a control group for a total reach of 20 hours.

5.2 After performing the learning model, the achievement test and working memory test were administered. Then, the tests were repeated by using the achievement test 2 weeks after the first time.

5.3 Scores obtained from the tests as well as the two-week-after test were statistically analyzed with an instant program.

5.4 The obtained data were analyzed using an independent sample t-test to compare learning achievement between the new Mnemonic - CAMR and inquiry learning cycle (Experiment group) and single inquiry learning cycle (Control group) for two weeks after Biodiversity class in senior high school students.

5.5 The obtained data were analyzed using an independent sample t-test to compare working memory between the experiment and control groups in the Biodiversity class of senior high school students.

Results

Learning retention

The comparison of students' learning retention after using new Mnemonic - CAMR together with inquiry learning cycle (Experiment group) and single using inquiry learning cycle (Control group). The average score of the biodiversity achievement test after two weeks (second after-class-test score) with a total score of 30 points was calculated and compared to 70% of the first test. Then the averages from the second test between the experiment and control groups were compared and shown in Table 1.

Table 1 The average, standard deviation, and independent t-test of learning retention of inquiry learning cycle (Control group) and new Mnemonic - CAMR together with inquiry learning cycle (Experiment group)

Sample group	*n*	First after-class test		Second after-class test		$\bar{X}2$-$\bar{X}1$	*t*	**p*
		$\bar{X}1$	*SD*	$\bar{X}2$	*SD*			
Control	45	17.02	4.08	11.62	2.53	-5.40	8.79	.000
Experiment	45	21.24	3.16	17.51	3.71	-3.73		

*p < .05

The result from Table 1 showed that the average learning retention of students provided with a single Inquiry learning cycle (Control group) in the first and second test are 17.02 and 11.62, respectively. The obtained result shows that students in this group have less retention than 70% of the first test. Meanwhile, the experiment group has an average score from the first and the second test at 21.24 and 17.51 points, respectively. The obtained result shows that students in the experiment group have higher retention than 70% of the first test.

Thus far, the difference between averages ($\bar{X}2$ - $\bar{X}1$) of the control group and experiment group in the first and the second after-class test are -5.40 and -3.37, respectively. The result shows a negative value of the second test in both groups. Due to the result, it is clear that the achievement score decreased in both groups, but less difference was found in the experimental group than in the control group. The statistic independent t-test analysis concludes that learning retention from students in the experiment group is significantly higher than students in the control group ($p < .05$).

Working memory

The comparison of students' working memory after using new Mnemonic - CAMR together with inquiry learning cycle (Experiment group) and single using inquiry learning cycle (Control group) is shown in Tables 2-3

Table 2 The average, standard deviation, and independent t-test of visuospatial short-term memory with forwarding block-tapping span type of inquiry learning cycle (Control group) and new Mnemonic - CAMR together with inquiry learning cycle (Experiment group)

Sample group	*n*	$\overline{X}$	*SD*	*df*	*t*	**p*
Control	45	6.93	1.95	44	14.35	.000
Experiment	45	11.63	1.83	44		

*p < .05

The results from Table 2 showed the average of working memory in visuospatial short-term memory with forwarding block-tapping span type of the students in the control group is 6.93 points, which is less than 70% of the total score. Meanwhile, the average score of the students in the experiment group is 11.63 points, which is higher than 70% of the total score. In summary, the students in an experiment group tend to have significantly better visuospatial short-term memory in working memory than those in the control group ($p < .05$).

Table 3 The average, standard deviation, and independent t-test of visuospatial Working memory with backward block-tapping span type of inquiry learning cycle (Control group) and new Mnemonic - CAMR together with inquiry learning cycle (Experiment group)

Sample group	*n*	$\overline{X}$	*SD*	*df*	*t*	**p*
Control	45	5.37	2.48	44	15.60	.001
Experiment	45	12.21	2.35	44		

*p < .05

Table 3 showed the average of working memory in the sense of visuospatial working memory with backward block-tapping span type of students in the control group is 5.37 points, which is less than 70% of the total score. Meanwhile, the average score of students in the experiment group is 12.21 points, which is higher than 70%.

This investigation shows that students provided with the experiment group tend to have significantly better visuospatial working memory in working memory than those who were provided with only the inquiry learning cycle. ($p < .05$).

Discussion

Findings of the research on the effects of new Mnemonic - CAMR together with inquiry learning cycle for enhancing learning retention and working memory were discussed as the followings:

1. Learning retention

Learning retention is the ability to memorize or accumulate what is being taught in the memory that could be recalled to solve problems or apply to different situations. As the time passed, the subsequent result after evaluated the change would be learning

retention. This conformed with Kamuche (2005), who stated that learning retention could retain and store what was learned inside the brain and recall them once needed (Adams, 1967). Mnemonic - CAMR, together with the inquiry learning cycle, could elevate students' learning retention. This included five steps as the followings:

Step 1 Engagement: there would be a cognition level of the new Mnemonic - CAMR at this level. The students would get on to new experiences and be stimulated by teachers about what they would be studying, including questioning and watching VDO. These allowed students to memorize and pay attention to lessons better. There was also a mnemonic in cognition level that students would write down basic information of knowledge they wanted to memorize onto the paper to prepare mnemonic sentences. Therefore, students had to pay attention to finding topics that would be used in forming sentences. To do this, students studied from VDO, games or questions answering, which conformed with the learning theory of Piaget, which stated that students would absorb information, images, or scenarios from what they learned (Bormanaki & Khoshhal, 2017) and Information processing theory which stated that input was stored as a short term memory (Klausmeier, 1985), which divided into two parts that were acknowledgment and interests. In the presence of Mnemonics - CAMR, recalling information would be better and eventually turn into long-term memory.

Step 2 Exploration: there would be a cognition and arrangement step of Mnemonic - CAMR at this level. The students would be an explorer who searched for information by themselves. Exploration step has cognition step of Mnemonic - CAMR which students would acquire both inquiry process, analyses of an approach to find information, team working processes, tasks assignment regarding skills of each individual. There was also an arrangement at this level. As to this, obtaining information and knowledge that wanted to memorize were arranged in a meaningful way regarding images and scenarios. This was considered the most important step for students to create their mnemonic sentences, which subsequently turned into long-term memory. This corresponds with information processing in encoding, which would be stored in long-term memory (Klausmeier, 1985). Teachers would provide guidelines for students to choose specific topics and use existing information to produce mnemonic sentences according to the selected topic.

Step 3 Explanation: there would be a memorization step of the new Mnemonic - CAMR at this level. Students would gather the information they got from research and investigations from previous steps, including analyzing and concluding the study results. Thus, students would acquire knowledge processing and practice explaining understandable things to listeners, absorbing additional information from extended studies. Moreover, there was also memorization of the new Mnemonic - CAMR which students would review and memorize their mnemonic sentences and present them in front of the class. Students would think of images and scenarios during the review according to the technique that the researchers constructed. This provided students with knowledge retention, memorization from short-term memory, which leading to long-term memory. In line with Information processing theory, it indicated that a relationship between existing knowledge and new knowledge could lead to knowledge being stored in long-term memory (Klausmeier, 1985).

Step 4 Elaboration: Students would have additional learning or an application of the knowledge they gained by having teachers provide guidance to be activated to think and analyze processes. The students could apply knowledge in the new situations that may be similar to the situation students already experienced and use gathered information to reasonably answer the questions and conclude the study results. In addition, students could also review vocabulary and other conclusions from teachers in more profound steps. Finally, it allowed students to review their knowledge and memory again, including improving their prior knowledge to complement the new knowledge in a meaningful way.

Step 5 Evaluation: there would be recognition of Mnemonics - CAMR at this level. In the last level of the inquiry learning cycle, students would evaluate themselves and their teammates to determine the extent to which knowledge and skills they had gained and which teachers might be involved in the evaluation. Apart from this, a recognition step of Mnemonic - CAMR allowed students to evaluate themselves and their teammates whether they memorized mnemonic sentences. It could be done by asking either general detail or topics. Students' evaluation of themselves and their teammates allowed them to know how much they memorized knowledge they had gained. It conformed with the Psychometric Theory of Intelligence of Guilford in the content dimension of thinking. It allows students to evaluate their recognition in the forms of images, voices, symbols, languages, and behaviors. This way, students would think of contextual images of mnemonic sentences, which said those sentences, including symbols and languages mixed into meaningful sentences. Over this, there was also stimulated behavior that could be an interaction between persons or social involvement with other people (Guilford, 1950; Kurtzberg & Amabile, 2001).

Therefore, the inquiry learning cycle allows students to attain learning retention and more extended memory. It helps students to turn short-term memory into long-term memory at a better rate. In line with Patrick and Urhievwejire (2012) research, students' learning retention in biology and chemistry after being taught by inquiry learning cycle was significantly higher than those taught by descriptive technique. In addition, post-test scores of students who studied with the inquiry learning cycle were increased in the management phase which corresponding to the results of the search conducted by Tuna and Kacar (2013) that compared learning outcome and learning retention of 10th grade students who learned trigonometry in math module by Inquiry Learning Cycle. It was found that the group studied by Inquiry Learning Cycle had better learning outcomes and learning retention than the group studied by normal method.

Not only inquiry learning cycle that affects learning retention but Mnemonic strategy also helps learners to memorize things too. Mnemonic promotes utilization of memorable ability of humans in creating learning benefits and supports memorization that easy to understand, which embedded in long term memory causing learners to have higher level of learning retention. This is in according with the research of Behr (2012) that studied Mnemonic used in memorizing second language vocabularies. This research studied Mnemonic technique that helped students to be more proficient in recalling new English vocabularies. The test was administered after three weeks in order to examine encoding in students' long-term memory. Results from the research found that reduction in vocabulary recall rate had lowest percent of differences between pretests and posttests. This lowest reduction pointed that it was the best long term memory encoding. Azmi et al.

(2016) researched the effectiveness of using mnemonic techniques in learning English vocabulary. Results of the study indicated that the students could remember the English words for a long time after being introduced to the mnemonic technique. It is also consistent with Safa & Hamzavi's (2013) research which studied the mnemonic method on vocabulary learning and long-term retention. The results found that subjects in the keyword group outperformed the memorization group significantly in learning and retaining the newly learned vocabularies. Moreover, the mnemonic method is an efficient vocabulary instruction technique as it leads to longer-term retention.

It could be seen in the results that our new Mnemonic - CAMR, together with inquiry learning which has both powerful strategies, could uplift the learning retention of students. It also helps students to memorize things better. It promotes the utilization of the memory ability of humans in creating learning benefits and supports memorization that is easy to understand, which is embedded in long-term memory, causing students to have a higher level of learning retention.

2. Working memory

One of the brain skills or Executive function (EF) is a skill that helps develop the frontal lobe, which allows humans to manage data in the cognitive system and mind effectively is a working memory or considered short term memory. Although working memory has limited capacity, it should be developed along with long-term memory to allow students to have more sustainable long-term memory. Sweatt (2010) stated that during work, information was retrieved from memory in order to be used in a brief period, which was a collection of temporary information. It was a collection and management of information in the cognitive process that consisted of information selection, the information receives, encoding, storing, and implementing information. It consisted of 5 steps as the following:

Step 1 Engagement level: there would be a new Mnemonic - CAMR cognition level at this level. Students would be stimulated by teachers, which is considered a way to direct students to the lesson by asking questions, discussing, doing an activity, or giving examples of daily situations. It could draw learners' attention and challenge them to feel curious, leading to inquiry or interest in learning. At this level, there was a gathering of basic information, components, vocabularies found from note-taking, observation, and listening to be ready to construct mnemonic sentences. It was compatible with a learning theory of Bloom that stated that cognition was an ability of the brain to preserve stories inside of it, which became specific knowledge in terms of vocabularies and definition or content comprehension (Bloom et al., 1956; Anderson et al., 2001). In addition, it allowed learners to use multiple skills during activities, especially memory skills, which would be the first skill learners would be using.

Step 2 Exploration: there would be cognition and arrangement of the new Mnemonic - CAMR at this level. After receiving partial information from the first step, students would investigate, find information, and learn from knowledge sources by themselves. From self-study, students could practice multiple processes, which enabled students to think of the answers, had complex thinking, or planned to search for knowledge by themselves, which there would be cognition of the new Mnemonic - CAMR in this level. According to students' curiosity to find new additional information as much as possible to form complete mnemonic sentences. Students were brainstorming to enumerate

information details and gain desired knowledge before moving onto the next level. There was also a meaningful arrangement of mnemonic, which allowed students to bring experience, knowledge, vocabularies, or any information to arrange into meaningful sentences or karaoke sentences or stories that allowed listeners to get a picture from a whole story. Students could practice working memory through complex thinking and associative thinking that linked each data into mnemonic sentences. For example, the meaning of sentences known in the past but may refer to vocabularies that rose from mnemonic sentences during the activity. This also aligned with the learning theory of Bruner that stated that learning methods that learners used as a tool to discover knowledge depended upon the development level of learners. Moreover, learners might imagine or crate vision in their minds. The use of symbols allowed learners to understand abstract and virtual learning that supported learning from intangibility.

Step 3 Explanation: there would be memorization of the new Mnemonic - CAMR at this level. Students would gather the information they obtained from research, experiment, or seek through methods then conclude. For example, after explaining and concluding the group, learners presented mnemonic sentences of the group and elaborated its content, vocabularies, including a further explanation about the concept of their mnemonic sentences. This allowed learners to practice working memory at this level. This was an exercise for short-term memory at a specific time that students had to be active in order to connect memory before giving a presentation and make use of cognition that just concluded in the previous level in providing a verbal explanation. This is consistent with Information processing theory, which states that human memory began with inputs from 5 senses and is stored inside in short-term memory, which could be retrieved during works. This caused behaviors, movements, and speeches (Klausmeier, 1985)

Step 4 Elaboration: in this level, students got to extend their existed knowledge through question answering and activities arranged by teachers with intentions to provide students with deeper and clearer knowledge. This could be done by connecting prior knowledge with new knowledge. Teachers also guided the conclusion and provided the correct knowledge through activities. Students were involved in activities during class, explained and gained additional knowledge, asked questions, and commented on situations that a teacher raised examples, including reviewing vocabularies and voting mnemonic sentences. This could be because of its correctness, completion of vocabularies, or meaning of the sentences that are easy to memorize or used. Apart from these, students could apply gained knowledge to other areas or scenarios, which allowed them to have a broader perspective.

Step 5 Evaluation: there would be recognition of the new Mnemonic - CAMR at this level. The knowledge and skills of students would be evaluated both by students and teachers. Students also evaluated themselves or their peers whether there was a progression of the knowledge through the questioning method. In addition, students got to practice memory skills in answering questions or doing activities, which required short-term memory that rose from learning and knowledge retrieval. More than these, there was also a recognition level of the new Mnemonic - CAMR that students and teachers got to evaluate mnemonic sentences together. For example, teachers asked students to read the whole Mnemonic sentences and asked where the first syllable came from or where the second syllable came from. Under information processing theory, this stated that stimuli

would be stored in the short-term memory within a limited time frame (Gurbin, 2015). Students could recall such data for use once needed by arranging and organizing the memory. Each person had different abilities to memorize things, where mnemonic could be employed to recall memory for use better (Bakken, 2017).

In addition to this, the new Mnemonic - CAMR also promoted students to have creativity, know how to utilize the benefits of languages, and allow students to use their prior knowledge. Apart from connecting memories in activities, students could also use them to make the Mnemonic - CAMR technique used in their learning. Mnemonic - CAMR technique helped students recognize using short-term memory while doing activity in a specific time, or this could be called working memory. This allowed students to look at the activity in a big picture or correctively thought of the preceding process (Dehn, 2008). For these reasons, Mnemonic - CAMR allowed students to develop working memory skills to be more effective. This aligned with the research of Nelson and Vu (2009), who compared results of mnemonic in recalling received passwords and a new password that the persons newly set for themselves. Memorizing passwords had vital interaction between types of passwords and the delay in recalling the memory in terms of times and numbers of times that participants tried to memorize their passwords correctly. The participants were trained to use mnemonics to memorize words that directed them to passwords they set for themselves. The study found that participants who trained with mnemonics to memorize new passwords set for themselves could recall faster and more accurately than those who trained to memorize received passwords. This is in line with the research of Choudhary and Choudhary (2016) who studied the use of Mnemonics in teaching technical vocabulary memorization for object-oriented programming. Normally, the system of this program is hard to memorize, that most students commented that they found it hard to memorize vocabularies used in this program. So, numbers of Mnemonic techniques were initiated and tested with students. Results of the memorization study were found to be better. For all vocabularies determination, students could memorize through single vocabulary, which considered the smallest part and easiest to memorize within the scope of the program.

Thus, it could be seen that the new Mnemonics - CAMR together with the inquiry learning cycle, could enhance working memory during the work of students at a significance level of .05.

In conclusion, this research highlights the new strategic Mnemonic - CAMR together with the inquiry learning cycle that researchers developed was simple and not costly. It promoted science teaching and could apply to students in developing countries. Moreover, we can apply each content and context of the children with intelligence and other skills development. It may help to enhance or practice them to be creative, memorize basic vocabularies or processes and components of knowledge in many fields that they need to memorize, and allow them to make good use of memory ability in their daily lives in the future.

Recommendations

General recommendations for the research

The recommendation would be to adjust the activity by allowing the teachers to hint to the engagement level at the end of the activity and let the learners seek or inquire for knowledge and form Mnemonics sentences before the next class. So that during the

class, students will begin to investigate and gather information again. Then, in explanation and conclusion levels, there will be Mnemonic sentences voting within the group of learners to identify the most appropriate Mnemonic sentence. The Mnemonic sentence that got voted will then have competed with other voted Mnemonic sentences from other groups. These allow learners to have enough time to form Mnemonic sentences and encourage every learner to think about forming Mnemonic sentences.

Recommendations for future research

There should be a study on learning management by Inquiry Learning Cycle (5Es) together with Mnemonic - CAMR with other factors that related to students such as communication, team working collaboration processes, ability to create memory forms, due to students' benefit in their daily lives and could be implemented in other subjects as well. The model may help enhance learners' creativity, memorize basic vocabularies or processes, learn components of knowledge, and make good use of memory ability in their daily lives.

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