Journal of World Englishes and Educational Practices
ISSN: 2707-7586
DOI: 10.32996/jweep
Journal Homepage: www.al-kindipublisher.com/index.php/jweep

JWEEP
AL-KINDI CENTER FOR RESEARCH AND DEVELOPMENT

| RESEARCH ARTICLE

Mind Mapping on Junior High School Performance in Chemistry

Lamberto A. Geolin Jr
High School Faculty, Tohatchi High School, Gallup-Mckinley County Schools, New Mexico, United States of America
Corresponding Author: Lamberto A. Geolin Jr., **E-mail**: lambertogeolin@gmail.com

| ABSTRACT

The study assessed the status of mind mapping as a strategy in teaching Grade 7 Chemistry at Zapatera National High School, Sikatuna St., Brgy. Zapatera, Cebu City, Cebu, Philippines. Each group were given two different treatments – the Control group having the chalk talk method and the Experimental group having the mind mapping for five (5) weeks. The pre-test revealed that both groups were described as "Poor". Among all the competencies tested, the distinguishing of mixtures from substances based on set properties got the lowest mean. After five (5) weeks, the post-test showed that the respondent's group performed differently. The Control group got a grand mean of 7.23, which is "Good" while the experimental group got 9.65, which is also "Good" but slightly higher than that of the control group. As to the significant difference in the post-test of the respondent groups, the Control group's performance revealed that there is a significant difference. Meanwhile, the Experimental group's post-test performance result is "Highly Significant". "Mind Mapping" as a strategy evidently showed a vital connection on the improvement of the Junior High School performance in Chemistry. It is more effective in both teaching and learning process as compared to the chalk talk method. Thus, the proposed learning activities is highly recommended.

| KEYWORDS

Chemistry, Learning activities, Mind mapping, Quasi-experimental Design, Dual-coding theory, Generative Learning Theory, Radiant Thinking Theory, Chalk Talk Method.

| ARTICLE INFORMATION

ACCEPTED: 01 April 2024 **PUBLISHED:** 23 April 2024 **DOI:** 10.32996/jweep.2024.6.1.13

1. Introduction

In Chemistry, a student has to understand and memorize a lot of concepts and facts. The students need to be diligent and hardworking by having to read and memorize the notes given by their teachers from their textbooks for them to answer correctly the chemistry questions and eventually pass the test. The National Achievement Test (NAT) is a set of examinations taken in the Philippines by students in Years 6, 10, and 12. Students are given national standardized test, designed to determine their academic levels, strengths, and weaknesses that, includes the subject Science.

The Department of Education in 2011 mentioned that almost two-thirds of the country's high schools did poorly in S.Y. 2009-2010 with 67.10 percent of these schools obtaining below average scores. In the field of science, it has been shown that students have not mastered the skills ranging from understanding or internalizing scientific data and information, to explaining scientific theories or laws, and being able to do the necessary calculations to solve scientific problems.

In Zapatera National High School, one of the problems is the low performance of the students during the National Achievement Test, especially in the area of Science. It is being showed in the Mean percentage Score of the students who took the exam in the school year of 2014-2015 which is only 53.80 percent. The science teachers discussed among themselves during the meeting that teachers should introduce a learning tool to the students to be used in understanding chemistry concepts. Furthermore, it is agreed that one of the learning tools to be introduced is the use of Mind Maps.

In addition, it has been observed that there is difficulty in teaching grade 7 students especially chemistry concepts, which really need thinking and analytical skills. The students had difficulty answering questions in chemistry because of their low analytical skills and poor understanding of chemistry concepts. However, it is believed that the innovation of teaching strategies by using a learning tool would change the performance of the students in chemistry, the results and findings of this study will help both teachers and students to better understand chemistry concepts. This will also help students to gain more learning outcomes and better performance and high achievement results. On the other hand, science teachers will be guided and directed on the use of learning tool through learning activities, which is a big help in teaching chemistry.

2. Literature Review

This study assumes that mind mapping can be an effective strategy for Junior High School Chemistry in Zapatera National High School. This study is anchored on Radiant Thinking Theory by Tony Buzan, Dual-coding Theory of Allan Paivio, and Generative Learning Theory of Merlin Wittrock.

The basic idea of Radiant Thinking is that each bit of information entering the brain, every sensation, memory or thought, which incorporates every word, number, code, food, fragrance, line, color, image, beat, note and texture can be represented as a central sphere from which radiate tens, hundreds, thousands, even millions of hooks.Each hook represents an association, and each association has its own infinite array of links and connections. From this gigantic information processing ability and learning capacity derives the concept of Radiant Thinking of which the Mind Map is a manifestation. The brain's radiant thinking pattern may thus be seen as a gigantic Branching Association Machine, a super bio computer with lines of thought radiating from a virtually infinite number of data nodes.

To further substantiate this idea, another theory supports this study. This is the Dual-coding Theory of Allan Paivio. Dual-coding theory stated that the idea that the formation of mental images aids in learning (Reed, 2010). According to Paivio, there are two ways a person could expand on learned material: verbal associations and visual imagery. Dual-coding theory postulates that both visual and verbal information is used to represent information (Sternberg, 2003). Visual and verbal information are processed differently and along distinct channels in the human mind, creating separate representations for information processed in each channel.

The mental codes corresponding to these representations are used to organize incoming information that can be acted upon, stored, and retrieved for subsequent use. Both visual and verbal codes can be used when recalling information (Sternberg, 2003). For example, say a person has stored the stimulus concept "dog" as both the word 'dog' and as the image of a dog. When asked to recall the stimulus, the person can retrieve either the word or the image individually, or both simultaneously. If the word is recalled, the image of the dog is not lost and can still be retrieved at a later point in time. The ability to code a stimulus two different ways increases the chance of remembering that item compared to if the stimulus was only coded one way.

There are limitations to the dual-coding theory. Dual-coding theory does not take into account the possibility of cognition being mediated by something other than words and images. Not enough research has been done to determine if words and images are the only way we remember items and the theory would not hold true if another form of codes were discovered. Another limitation of the dual-coding theory is that it is only valid for tests on which people are asked to focus on identifying how concepts are related (Reed, 2010). If associations between a word and an image cannot be formed, it is much harder to remember and recall the word at a later point in time. While this limits the effectiveness of the dual-coding theory, it is still valid over a wide range of circumstances and can be used to improve memory (Reed, 2010).

Many researchers have agreed that only words and images are used in mental representation. Supporting evidence shows that memory for some verbal information is enhanced if a relevant visual is also presented or if the learner can imagine a visual image to go with the verbal information. Likewise, visual information can often be enhanced when paired with relevant verbal information, whether real-world or imagined. This theory has been applied to the use of multimedia presentations. Because multimedia presentations require both spatial and verbal working memory, individuals dually code information presented and are more likely to recall the information when tested at a later date (Brunye, Taylor, & Rapp, 2008).

Paivio found that participants when shown a rapid sequence of pictures as well as a rapid sequence of words and later asked to recall the words and pictures, in any order, were better at recalling images. Participants, however, more readily recalled the sequential order of the words, rather than the sequence of pictures. These results supported Paivio's hypothesis that verbal information is processed differently from visual information and that verbal information was superior to visual information when sequential order was also required for the memory task. Lee Brooks conducted an experiment that provided additional support for two systems for memory. He had participants perform either a visual task, where they had to view a picture and answer questions about the picture, or a verbal task, where they listened to a sentence and were then asked to answer questions pertaining to the sentence. To respond to the questions, participants were asked to either respond verbally, visually, or manually. Through this experiment, Brooks found that interference occurred when a visual perception was mixed with manipulation of the visual task, and verbal responses interfere with a task involving a verbal statement to be manually manipulated. This supported the idea of two codes used to mentally represent information (Sternberg 2003).

Aside from the two theories mentioned earlier, another theory that can support this study is known as Generative Learning Theory of Merlin Wittrock.

Generative Learning Theory states that as we make connections between our existing schema and new information, our knowledge base changes, and new information is formed. The learner must be an active participant in the learning process. Through articles and books, he has emphasized the importance of transfer, prior learning, and the interaction of student characteristics and instructional methods. The focus is on the learner. Wittrock (1992) made it clear that the learner is not a passive participant, but an active participant in the learning process.

There are four components to this learning theory. They are: motivation, learning, knowledge creation, and generation. There are two types of activities that can generate new schema. The first includes activities that generate organizational relationships. This can include things such as headings, titles, objectives, tables, and graphs. The second includes activities that generate relationships between the external stimuli and the memory components. This can include pictures, applications, inferences and demonstrations. All activities must create relationships and make meaning, not simply restructure information.

Relationships are built across subject areas, through thematic units and other instruction methods. Relationships must also be built between what students already know (schema) and what they are learning. The teacher's job becomes more than simply telling students' information. They must teach and facilitate. Activities must be designed so students control their learning. Students must use meta-cognitive thinking and self-control strategies to direct their learning. Generative learning is a neural process in which the brain is in control. The ultimate goal is for students to create relationships. Instruction must be designed to facilitate this.

In order to build these necessary relationships, students must be asked appropriate questions and given appropriate assignments. Assignments should give students the opportunity to form new schema. Students should work with manipulatives, models, and diagrams. They should be expected to form opinions and evaluate situations. When reading, comprehension should be assessed based on how students make connections between the book and their schema. Students should also be given the opportunity to make connections between what they are learning in science and reading. For example, if the reading selection of the week is about the desert habitat, in science, students could explore this from a scientific point of view, talking about the basic needs of animals and plants that live there, the life cycle of a plant, the food chain, etc… By making these connections, students are more likely to form new background knowledge.

Kyu Yon Lim (2008) stated in his dissertation, "The effect of concept mapping with different levels of generativity and learners' self-regulated learning skills on knowledge acquisition and representation" that In generative learning, learners have an active, participatory role in order to interpret and construct meaning. "The essence of the generative learning model is that the mind, or the brain, is not a passive consumer of information. Instead, it actively constructs its own interpretations and draws inferences from them". Meaning making, he claims, occurs in two ways: The different parts of external information are conceptually woven together in a meaningful way. Alternatively, external information and the learner's schema are integrated to generate new knowledge.

Thus, from an instructional strategies standpoint, Wittrock (1990, 1991)claimed that only those activities that involve the actual creation of relationships and meaning are classified as examples of generative learning strategies. That is, well-designed instruction should support learners' organization and integration of new information into an existing knowledge structure to promote meaningful learning. Considering that the construction of conceptual relationships is the key to knowledge generation, concept mapping has the potential to be one of the more powerful strategies to support the process of meaning-making.

A mind map is a highly effective way of getting information in and out of the brain. It is a creative and logical means of note-taking and note-making that literally "maps out" ideas. All mind maps have some things in common. They have a natural organizational structure that radiates from the center and use lines, symbols, words, color and images according to simple, brain-friendly concepts. A mind map converts a long list of monotonous information into a colorful, memorable and highly organized diagram that works in line with your brain's natural way of doing things.

One simple way to understand a mind map is by comparing it to a map of a city. The city center represents the main idea; the main roads leading from the center represent the key thoughts in your thinking process; the secondary roads or branches represent your secondary thoughts, and so on. Special images or shapes can represent landmarks of interest or particularly relevant ideas.

The mind map is the external mirror of the radiant or natural thinking facilitated by a powerful graphic process, which provides the universal key to unlock the dynamic potential of the brain.

The five essential characteristics of a mind map: (1)the main idea, subject or focus is crystallized in a central image; (2) the main themes radiate from the central image as 'branches'; (3) the branches comprise a key image or key word drawn or printed on its associated line; (4) topics of lesser importance are represented as 'twigs' of the relevant branch; (5) the branches form a connected nodal structure.

Many studies have been conducted all over the world to try out different methods in developing creativity through the use of mind maps in teaching. Budd (2003) mentioned that to move beyond "chalk and talk" by incorporating active and collaborative learning into economics courses, instructors can use a variety of exercises and tools. One such exercise is the in-class creation of mind maps on a specific topic by small groups of students. Buzan and Buzan (2006) argue that mind maps better harness the way the brain works. The radiant structure is consistent with the radiant nature of the brain. The use of colors, graphics, and nonlinear branches stimulates the entire brain.

Although these reasons potentially make mind maps powerful tools, the usefulness as a classroom exercise is not dependent on any claimed superiority of mind maps over other forms of outlining and categorization. The benefits of this exercise are derived from its active and collaborative nature. Modifying the popular collaborative, active learning exercise "think-pair-share", the mind map exercise is "think-rap-map"; and the uniqueness of this activity relative to usual course activities can connect with diverse learning styles and reenergize a course.

Edwards and Cooper (2010) said life is inevitably busy, and it is possible to keep a set of notes that takes only minutes to review before each session. This can make preparing for a teaching session less demanding on time. There are three ways in which mind maps can help prepare and review teaching sessions : writing notes, updating notes and reminding. Before the initial teaching session of a new topic, mind maps would allow notes to be made from key texts and papers very quickly. After reading key information, summarise all that information on several sheets of paper, as opposed to copying paragraphs of text verbatim. Taking this information from several sources and condensing it to several pages of key topics, and keywords, allows consolidation of the work. Using both sides of the brain and mapping the information out allows seeing how the information interrelates. Conversely, if given atopic with several key headings to follow, use each of these key headings as a central idea, allowing mapping the information, ensuring all key information was present. All the above studies showed that mind map is effective in language creativity and its success brings more classroom activities to produce new ideas and new combinations.

Furthermore, Edwards and Cooper (2010) explained that there are many ways that using a mind map can assist in the teaching of students, one of which is as a prompt and revision tool. It is possible to use a mind map as a prompt, like as a set of cue cards. The mind map could be set to match presentation slides. As the keywords and key topics would be clearly identified, this would help ensure everything that needs to be taught is taught. A completed mind map could be given to students as a summary for the coming term, tutorial or lecture. This would allow students to prepare by focusing on key topics only, and not diverging on a tangent. It is possible to teach a class by mind mapping. Give first the key central idea on a board to the class. Next, the teacher would discuss with the students what they think are the key topics. This would allow students to become engaged in the discussion, and involved by writing-up these ideas. Each topic would be individually discussed and a mind map drawn up. This would allow the students to see a topic and how everything within this topic links together. As the students get involved in creating this map it retains their interest, as they are involved in the development of the topic.

In a mind map the main study topic is drawn at the centre with keywords branching out in a divergent pattern. These key words correspond to subtopics and then smaller branches project from the subtopics with further details regarding the subject being included in a progressively branching pattern. By undergoing this process, information initially contained within passages of text becomes hierarchically organized, with the most general information being presented in the centre of the mind map and material of increasing detail being presented at the extremes (Farrand et al., 2002). It is used to generate, visualize, structure and classify ideas, and as an aid in study, organization, problem solving, and decision making. The elements are arranged intuitively according to the importance of the concepts and they are organized into groups, branches, or areas. The uniform graphic formulation of the semantic structure of information on the method of gathering knowledge, may aid recall of existing memories.
Mind maps can be used as self-learning methods, which enhance the focus on salient rather than irrelevant aspects. It also facilitates the achievement of a conceptual understanding of the fundamental principles of a huge amount of information and enables to assemble and integrate many concepts together. Mind maps promote active learning. Analysis of the data indicates that, as a strategy to improve memory for written information, the mind map technique has the potential for an important improvement in efficacy (Farrand et al., 2002).

Medical schools have been changing their educational programs and teaching strategies, at national and international levels, to ensure that students have active responsibility for their learning process and are prepared for life-long, self-directed learning (West et al., 2002).

Radiant Thinking Theory expresses the idea that every single information received by the brain correlates from ten to even millions of other linkages or association. This concept clearly coincides with which mind map conveys.

The Dual-Coding Theory on the other hand states the importance of mental images as associated with the verbal information, in assisting learning. This theory supports the idea of mind map which converts monotonous information into a diagram which is highly memorable as compared to plain texts.

Lastly, the Generative Learning Theory expresses the idea that every new information should be connected to an existing schema in order to form a new information. This concept also supports the idea of mind map which associates every small information to the existing main information.

All these theories, along with its related studies, supported this study that mind mapping can be effective strategy for Junior High School Chemistry. This clearly proves that mind mapping is an effective strategy in forming and retrieving new information which greatly helps in the learning process.

3. Methodology

The study used quasi- experimental design. This design involved two groups ; the controlled group and the experimental group.Pre-tests and post-tests were given to both groups; however, the intervention was introduced only to the experimental group. The results of the pre-tests from both groups assessed the extent to which the two groups are truly similar. On the other hand, results of the post-tests were compared; this assumed that the result from the experimental group was greater than the result from the controlled groupdue to its exposure to a certain intervention. The result between the pre-test and post-test from each group was also identified to see a significant difference. This design was used to ascertain the extent of influence of mind map as a learning tool for Junior High School Chemistry.

4. Results and Discussion

4.1 Pre-Test and Post-Test Performances of The Control and Experimental Group on The Grade 7 First Quarter Competencies

This part presents the pre-test and post-test performances of the control and experimental groups of the Grade 7 students on Investigating properties of unsaturated or saturated solutions. This is observed by the respondents shown in Table 1, Table 2, Table 3, Table 4, Table 5, and Table 6.

Table 1 presents the pre-test and post-test performances of the control and experimental groups of the Grade 7 students on investigating properties of unsaturated and saturated solutions.

Table 1 : Pre-test and Post-test Performances of the Control and Experimental Groups on Investigating Properties of Unsaturated and Saturated Solutions

Range of Scores	Control Group						Experimental Group					
	Pre-test			Post-test			Pre-test			Post-test		
	f	%	Verbal Rating	f	%	Verbal Rating	f	%	Verbal Rating	f	%	Verbal Rating
10-12	0	0	VG	3	10	VG	0	0	VG	15	50	VG
7-9	4	13	G	20	67	G	2	7	G	15	50	G
4-6	16	53	F	7	23	F	21	70	F	0	0	F
3 below	10	33	P	0	0	P	7	23	P	0	0	P
Total	30	100		30	100		30	100		30	100	
Mean	4.33			7.63			4.50			9.70		
sd	2.070						1.827					

Legend: **VG** – Very Good **G** – Good **F** – Fair **P** – Poor

Score Ranges	**Verbal Rating**
10-12	Very Good
7-9	Good
4-6	Fair
3 below	Poor

Table 1 shows that most of the pre-test scores of the control group were fair, while only 4 students or 13 percent got good performance. Ten students or 33 percent got poor performance. It means that majority of the students need to learn more and understand better on this competency. As to the pre-test scores of the experimental group, 21 out of 30 or 70 percent got fair performance, while only 2 or 7 percent got good performance. It means that most of the grade 9 students need mastery and understanding of this competency. The control group has a mean score of 4.33 in the pre-test while the experimental group has a mean score of 4.50. It shows that students on both groups had the same level of understanding with regard to the competency. This also shows that the students in the control and experimental groups are comparable.

Table 1 further shows the post-test performances of the control and experimental groups. Majority of the students in the control group had good performance, which is 20 out of 30 students or 67 percent, while 7 or 23 percent got fair performance. Only 3 or 10 percent got a very good performance. There is an increase in the performance of the students who are exposed to chalk talk method in presenting the topics. It means chalk talk method is a good method in teaching science concepts. In the experimental group, 15 out of 30 or 50 percent got good performance, while 15 or 50 percent also got a very good performance. No one got fair and poor performance. It showed that the use of mind map in teaching greatly improve the performance of the students because majority of the students in the experimental group got a good and very good performance. The experimental group has slightly higher mean (mean = 9.70) compared to the control group (mean = 7.63).

Table 2 presents the pre-test and post-test performances of the control and experimental groups of the Grade 7 students on distinguishing mixtures from substances based on set properties

Table 2 : Pre-test and Post-test Performances of the Control and Experimental Groups on Distinguishing Mixtures from Substances Based on Set Properties

Range of Scores	Control Group						Experimental Group					
	Pre-test			Post-test			Pre-test			Post-test		
	f	%	Verbal Rating	f	%	Verbal Rating	f	%	Verbal Rating	f	%	Verbal Rating
10-12	0	0	VG	0	0	VG	0	0	VG	14	47	VG
7-9	0	0	G	8	27	G	2	7	G	13	43	G
4-6	10	33	F	22	73	F	8	27	F	3	10	F
3 below	20	67	P	0	0	P	20	67	P	0	0	P
Total	30	100		30	100		30	100		30	100	
Mean	3.03			5.87			3.37			9.30		
sd	1.663						1.999					

Table 2 shows that most of the pre-test scores of the control group were poor, while 10 students or 33 percent got fair performance. It means that majority of the students need to learn more and understand better on this competency. As to the pre-test scores of the experimental group, 20 out of 30 or 67 percent got poor performance, while only 2 or 7 percent got good performance. It means that most of the grade 9 students need mastery and understanding on this competency. The control group has a mean score of 3.03 in the pre-test while the experimental group has a mean score of 3.37. It shows that students on both groups had the same level of understanding with regards to the competency. This also shows that the students in the control and experimental groups are comparable.

Table 2 further shows the post-test performances of the control and experimental groups. Majority of the students in the control group had fair performance, which is 22 out of 30 students or 73 percent, while 8 or 27 percent got good performance. In the experimental group, 14 out of 30 or 47 percent got very good performance, while 13 or 43 percent got good performance. Only 3 or 10 percent got fair performance. The experimental group has slightly higher mean (mean = 9.30) compared to the control group (mean = 5.87).

Table 3 presents the pre-test and post-test performances of the control and experimental groups of the Grade 7 students on recognizing substances classified as elements and compounds.

Table 3 : Pre-test and Post-test Performances of the Control and Experimental Groups on Recognizing Substances Classified as Elements and Compounds

Range of Scores	Control Group						Experimental Group					
	Pre-test			Post-test			Pre-test			Post-test		
	f	%	Verbal Rating	f	%	Verbal Rating	f	%	Verbal Rating	f	%	Verbal Rating
10-12	0	0	VG	1	3	VG	0	0	VG	13	43	VG
7-9	1	3	G	21	70	G	2	7	G	17	57	G
4-6	12	40	F	7	23	F	23	77	F	0	0	F
3 below	17	57	P	1	3	P	5	17	P	0	0	P
Total	30	100		30	100		30	100		30	100	
Mean	3.43			7.33			4.73			9.30		
sd	2.412						2.079					

Table 3 shows that most of the pre-test scores of the control group were poor, while 12 students or 40 percent got fair performance. Only 1 or 3 percent got good performance. It means that majority of the students need to learn more and understand better on this competency. As to the pre-test scores of the experimental group, 23 out of 30 or 77 percent got fair performance, while only 2 or 7 percent got good performance. It means that most of the grade 9 students need mastery and understanding of this competency. The control group has a mean score of 3.43 in the pre-test while the experimental group has a mean score of 4.73. It shows that students on both groups had the same level of understanding with regards to the competency. This also shows that the students in the control and experimental groups are comparable.

Table 3 further shows the post-test performances of the control and experimental groups. Majority of the students in the control group had fair performance, which is 21 out of 30 students or 70 percent, while 7 or 23 percent got good performance. Only 1 or 3 percent got very good performance. In the experimental group, 17 out of 30 or 57 percent got good performance, while 13 or 43 percent got very good performance. The experimental group has slightly higher mean (mean = 9.30) compared to the control group (mean = 7.33).

Table 4 presents the pre-test and post-test performances of the control and experimental groups of the Grade 7 students on investigating properties of acidic and basic mixtures.

Table 4 : Pre-test and Post-test Performances of the Control and Experimental Groups on Investigating Properties of Acidic and Basic Mixtures

Range of Scores	Control Group						Experimental Group					
	Pre-test			Post-test			Pre-test			Post-test		
	f	%	Verbal Rating	f	%	Verbal Rating	f	%	Verbal Rating	f	%	Verbal Rating
10-12	0	0	VG	12	40	VG	0	0	VG	25	83	VG
7-9	2	7	G	8	27	G	2	7	G	5	17	G
4-6	14	47	F	10	33	F	15	50	F	0	0	F
3 below	14	47	P	0	0	P	13	43	P	0	0	P
Total	30	100		30	100		30	100		30	100	
Mean	3.77			8.23			3.63			10.70		
sd	3.037						1.929					

Table 4 shows that most of the pre-test scores of the control group was fair and poor, 14 students or 47 percent got fair performance while 14 or 47 percent also got poor performance. Only 2 or 7 percent got good performance. It means that majority of the students need to learn more and understand better on this competency. As to the pre-test scores of the experimental group, 15 out of 30 or 50 percent got fair performance, while only 2 or 7 percent got good performance. It means that most of the grade 9 students need mastery and understanding of this competency. The control group has a mean score of 3.77 in the pre-test while the experimental group has a mean score of 3.63. It shows that students on both groups had the same level of understanding with regards to the competency. This also shows that the students in the control and experimental groups are comparable.

Table 4 further shows the post-test performances of the control and experimental groups. Majority of the students in the control group had very good performance, which is 12 out of 30 students or 40 percent, while 8 or 27 percent got good performance. There was 10 or 33 percent got fair performance. In the experimental group, 25 out of 30 or 83 percent got very good performance, while 5 or 17 percent got good performance. No one got fair and poor performance. The experimental group has slightly higher mean (mean = 10.70) compared to the control group (mean = 8.33).

Table 5 presents the pre-test and post-test performances of the control and experimental groups of the Grade 7 students on describing some properties of metals and non-metals.

Table 5 : Pre-test and Post-test Performances of the Control and Experimental Groups on Describing Some Properties of Metals and Non-metals

Range of Scores	Control Group						Experimental Group					
	Pre-test			Post-test			Pre-test			Post-test		
	f	%	Verbal Rating	f	%	Verbal Rating	f	%	Verbal Rating	f	%	Verbal Rating
10-12	0	0	VG	2	7	VG	0	0	VG	13	43	VG
7-9	0	0	G	17	57	G	1	3	G	16	53	G
4-6	18	60	F	11	37	F	18	60	F	1	3	F
3 below	12	40	P	0	0	P	11	37	P	0	0	P
Total	**30**	**100**		**30**	**100**		**30**	**100**		**30**	**100**	
Mean	**3.77**			**7.07**			**3.67**			**9.27**		
sd	**1.985**						**2.500**					

Table 5 shows that most of the pre-test scores of the control group were fair, which is 18 or 60 percent while 12 students or 40 percent got fair performance. No one got good and very good performance. It means that majority of the students need to learn more and understand better on this competency. As to the pre-test scores of the experimental group, 18 out of 30 or 60 percent got fair performance, while only 1 or 3 percent got good performance. It means that most of the grade 9 students need mastery and understanding of this competency. The control group has a mean score of 3.77 in the pre-test while the experimental group has a mean score of 3.67. It showed that students on both groups had the same level of understanding with regards to the competency. This also shows that the students in the control and experimental groups are comparable.

Table 5 further shows the post-test performances of the control and experimental groups. Majority of the students in the control group had good performance, which is 17 out of 30 students or 57 percent, while 11 or 37 percent got fair performance. There were only 2 or 7 percent got very good performance. In the experimental group, 16 out of 30 or 53 percent got good performance, while 13 or 43 percent got good performance. Only 1 or 3 percent got fair and no one got poor performance. The experimental group has slightly higher mean (mean = 9.27) compared to the control group (mean = 7.07).

Table 6 presents the summary of the pre-test and post-test means of the control and experimental groups of the Grade 7 students on the five first quarter competencies.

Table 6 : Summary of the Pre-test and Post-test Mean of the Control and Experimental Groups

	Competencies	CONTROL GROUP				EXPERIMENTAL GROUP			
		Pre-test		Post-test		Pre-test		Post-test	
		Mean	Verbal Rating	Mean	Verbal Rating	Mean	Verbal Rating	Mean	Verbal Rating
1.1	Investigating properties of unsaturated or saturated solutions	4.33	F	7.63	G	4.50	F	9.70	G
1.2	Distinguishing mixtures from substances based on set properties	3.03	P	5.87	F	3.37	P	9.30	G
1.3	Recognizing substances classified as elements and compounds	3.43	P	7.33	G	4.73	F	9.30	G
1.4	Investigating properties of acidic and basic mixtures	3.77	P	8.23	G	3.63	P	10.70	VG
1.5	Describing some properties of metals and non-metals	3.77	P	7.07	G	3.67	P	9.27	G
	Grand Mean	**3.67**	**P**	**7.23**	**G**	**3.98**	**P**	**9.65**	**G**

Table 6 shows that the grand mean of the pre-test of the control group is poor, which is 3.67. However in the post-test, it is being showed that it rises up to a grand mean of 7.23, which is a good performance. In the experimental group, the pre-test grand mean is also poor, which is 3.98. However, in the post-test, the grand mean is 9.65, which is also a good performance. It means that the experimental group performed better than the control group in all the aforementioned competencies. Further, it also shows that the use of mind mapping as a strategy helped the grade 7 performance in chemistry.

4.2 The Significant Differences of Pre – Test And Post – Test Performance Of The Control And Experimental Groups On Science 7 First Quarter Competencies

Table 7 shows the significant difference of the pre-test and post – test performance of the control and experimental groups in this competency. Both of the control and experimental group have the same sample size which is 30 in pre – test and post – test.

Table 7 : The Significant Difference of the Pre-test and Post – Test Performance of the Control and Experimental Group on Investigating Properties of Unsaturated and Saturated Solutions

Statistics	Control		Experimental		Post-test Control VS Experimental	
	Pre-test	Post-test	Pre-test	Post-test	Control	Experimental
Mean	4.33	7.63	4.50	9.70	7.63	9.70
sd	2.070		1.827		1.65	1.18
n	30		30		30	30
df	29		29		58	
t	-8.73		-15.59		-5.58	
p value	0.0000**		0.0000**		0.0000**	

Legend: * - significant at 5% ** - highly significant at 1%

Table 7 revealed that in the control group, the mean of the pre-test is 4.33 while in post – test is 7.63. There is an increase of mean of the said competency. The mean difference between the pre – test and post – test is 3.30 which means that there was an increase of the performance of the respondents in this competency. The standard deviation of the control group is 2.070. In the experimental group, the mean of the pre – test is 4.50 whereas the post – test is 9.70. The mean difference between the pre-test and post-test is 5.20, this means that the performance of the respondents has an increase on this competency. The experimental group's standard deviation is 1.827. There is a difference of standard deviation of control and experimental group in this competency.

Table 7 also showed that the value of t in the control group is -8.73 and the p value is 0.0000 which is less than 1 percent considering it as highly significant. The experimental group test results to a t value of -15.59 and a p value of 0.0000 which is also less than 1 percent which is considered as highly significant. This reveals that the experimental group performed better compared to the control group. It further showed the post-test performance of the control versus experimental group. Control group has a mean of 7.63 while experimental group has 9.70. The mean difference is 2.07. The standard deviation of the control group is 1.65 whereas the experimental group is 1.18, which means that the experimental group has a greater performance compared to the control group in this specific competency. The table also showed that the t value is -5.58 and the p value is 0.0000 which is less than 1 percent making it highly significant.

4.2.1 Distinguishing Mixtures from Substances Based on Set Properties

Table 8 shows the significant difference of the pre-test and post – test performance of the control and experimental groups in this competency. Both of the control and experimental group have the same sample size which is 30 in pre – test and post – test.

Table 8 : The Significant Difference of the Pre-test and Post – Test Performance of the Control and Experimental Group on Distinguishing Mixtures from Substances Based on Set Properties

Statistics	Control		Experimental		Post-test Control VS Experimental	
	Pre-test	Post-test	Pre-test	Post-test	Control	Experimental
Mean	3.03	5.87	3.37	9.30	5.87	9.30
sd	1.663		1.999		1.36	1.76
n	30		30		30	30
df	29		29		58	
t	-9.33		-16.26		-8.45	
p value	0.0000**		0.0000**		0.0000**	

Table 8 revealed that in the control group, the mean of the pre-test is 3.03 while in post – test is 5.87. There is an increase of mean of the said competency. The mean difference between the pre – test and post – test is 2.84, which means that there was an increase of the performance of the respondents in this competency. The standard deviation of the control group is 1.663. In the experimental group, the mean of the pre – test is 3.37 whereas the post – test is 9.30. The mean difference between the pre-test and post-test is 5.93, this means that the performance of the respondents has an increase on this competency. The experimental group's standard deviation is 1.999. There is a difference of standard deviation of control and experimental group in this competency.

Table 8 also showed that the t value in the control group is -9.33 and the p value is 0.0000 which is less than 1 percent considering it as highly significant. The experimental group test results to a t value of -16.26 and a p value of 0.0000 which is also less than 1 percent which is considered as highly significant. This reveals that the experimental group performed better compared to the control group. It further showed the post-test performance of the control versus experimental group. Control group has a mean of 5.87 while experimental group has 9.30. The mean difference is 3.43. The standard deviation of the control group is 1.36 whereas the experimental group is 1.76, which means that the experimental group has a greater performance compared to the control group in this specific competency. The table also showed that the t value is -8.45 and the p value is 0.0000 which is less than 1 percent making it highly significant.

Table 9 shows the significant difference of the pre-test and post – test performance of the control and experimental groups in this competency. Both of the control and experimental group have the same sample size which is 30 in pre – test and post – test.

Table 9 : The Significant Difference of the Pre-test and Post – Test Performance of the Control and Experimental Group on Recognizing Substances Classified as Elements and Compounds

Statistics	Control		Experimental		Post-test Control VS Experimental	
	Pre-test	Post-test	Pre-test	Post-test	Control	Experimental
Mean	3.43	7.33	4.73	9.30	7.33	9.30
sd	2.412		2.079		1.56	1.34
n	30		30		30	30
df	29		29		58	
t	-8.86		-12.03		-5.23	
p value	0.0000**		0.0000**		0.0000**	

Table 9 revealed that in the control group, the mean of the pre-test is 3.43 while in post – test is 7.33. There is an increase in mean of the said competency. The mean difference between the pre – test and post – test is 3.90, which means that there was an increase of the performance of the respondents in this competency. The standard deviation of the control group is 2.412. In the experimental group, the mean of the pre – test is 4.73 whereas the post – test is 9.30. The mean difference between the pre-test and post-test is 4.57. This means that the performance of the respondents has an increase in this competency. The experimental group's standard deviation is 2.079. There is a difference in standard deviation of control and experimental group in this competency.

Table 9 also showed that the t value in the control group is -8.86 and the p value is 0.0000 which is less than 1 percent considering it as highly significant. The experimental group test results to a t value of -12.03 and a p value of 0.0000 which is also less than 1 percent which is considered as highly significant. This reveals that the experimental group performed better compared to the control group. It further showed the post-test performance of the control versus experimental group. Control group has a mean of 7.33, while the experimental group has 9.30. The mean difference is 1.97. The standard deviation of the control group is 1.56 whereas the experimental group is 1.34, which means that the experimental group has a greater performance compared to the control group in this specific competency. The table also showed that the t value is -5.23 and the p value is 0.0000 which is less than 1 percent making it highly significant.

Table 10 shows the significant difference of the pre-test and post – test performance of the control and experimental groups in this competency. Both of the control and experimental group have the same sample size which is 30 in pre – test and post – test.

Table 10: The Significant Difference of the Pre-test and Post – Test Performance of the Control and Experimental Group on Investigating Properties of Acidic and Basic Mixtures

Statistics	Control		Experimental		Post-test Control VS Experimental	
	Pre-test	Post-test	Pre-test	Post-test	Control	Experimental
Mean	3.77	8.23	3.63	10.70	8.23	10.70
sd	3.037		1.929		2.46	1.24
n	30		30		30	30
df	29		29		58	
t	-8.06		-20.07		-4.91	
p value	0.0000**		0.0000**		0.0000**	

Table 10 revealed that in the control group, the mean of the pre-test is 3.77 while in post – test is 8.23. There is an increase of mean of the said competency. The mean difference between the pre – test and post – test is 4.46, which means that there was an increase of the performance of the respondents in this competency. The standard deviation of the control group is 3.037 In the experimental group, the mean of the pre – test is 3.63 whereas the post – test is 10.70. The mean difference between the pre-test and post-test is 7.07, this means that the performance of the respondents has an increase on this competency. The experimental group's standard deviation is 1.929. There is a difference in standard deviation of control and experimental group in this competency.

Table 10 also showed that the t value in the control group is -8.06 and the p value is 0.0000 which is less than 1 percent considering it as highly significant. The experimental group test results to a t value of -20.07 and a p value of 0.0000 which is also less than 1 percent which is considered as highly significant. This reveals that the experimental group performed better compared to the control group. It further showed the post-test performance of the control versus experimental group. Control group has a mean of 8.23 while experimental group has 10.70. The mean difference is 2.47. The standard deviation of the control group is 2.46 whereas the experimental group is 1.24, which means that the experimental group has a greater performance compared to the control group in this specific competency. The table also showed that the t value is -4.91 and the p value is 0.0000 which is less than 1 percent making it highly significant.

Table 11 shows the significant difference of the pre-test and post – test performance of the control and experimental groups in this competency. Both of the control and experimental group have the same sample size which is 30 in pre – test and post – test.

Table 11 : The Significant Difference of the Pre-test and Post – Test Performance of the Control and Experimental Group on Describing Some Properties of Metals and Non-metals

Statistics	Control		Experimental		Post-test Control VS Experimental	
	Pre-test	Post-test	Pre-test	Post-test	Control	Experimental
Mean	3.77	7.07	3.67	9.27	7.07	9.27
sd	1.985		2.500		1.510	1.720
n	30		30		30	30
df	29		29		58	
t	-9.10		-12.27		-5.27	
p value	0.0000**		0.0000**		0.0000**	

Table 11 revealed that in the control group, the mean of the pre-test is 3.77 while in post – test is 7.07. There is an increase in mean of the said competency. The mean difference between the pre – test and post – test is 3.30, which means that there was an increase of the performance of the respondents in this competency. The standard deviation of the control group is 1.985. In the experimental group, the mean of the pre – test is 3.67 whereas the post – test is 9.27. The mean difference between the pre-test and post-test is 5.60. This means that the performance of the respondents has an increase on this competency. The experimental group's standard deviation is 2.500. There is a difference in standard deviation of control and experimental group in this competency.

Table 11 also showed that the t value in the control group is -9.10 and the p value is 0.0000 which is less than 1 percent, considering it as highly significant. The experimental group test results to a t value of -12.27 and a p value of 0.0000 which is also less than 1 percent which is considered as highly significant. This reveals that the experimental group performed better compared to the control group. It further showed the post-test performance of the control versus experimental group. Control group has a mean of 7.07 while experimental group has 9.27. The mean difference is 2.20. The standard deviation of the control group is 1.510 whereas the experimental group is 1.720, which means that the experimental group has a greater performance compared to the control group in this specific competency. The table also showed that the t value is -5.27 and the p value is 0.0000 which is less than 1 percent making it highly significant.

These data imply that with the use of mind map in teaching greatly improves the performance of the students because majority of the students in the experimental group got a good and very good performance. Chalk talk method is also a good method in teaching science concepts since there is also increase in the performance of the students who are exposed to chalk talk method in presenting the topics.

Further, it is also shown that there were gains in score and improvement of student's performance both in the control and experimental groups. It means that the two methods of teaching helped improve students' performance on this competency.

However, it was evident that the use of mind map in teaching grade 7 Chemistry greatly affects students' learning and the students performed better in chemistry when they were taught using mind maps because they were actively involved in teaching-learning process.

5. Conclusion

The study conducted at Zapatera National High School in Cebu City aimed to assess the effectiveness of mind mapping as a teaching strategy for Grade 7 Chemistry, focusing on competencies like investigating properties of solutions, distinguishing mixtures from substances, recognizing elements and compounds, exploring acidic and basic mixtures, and describing properties of metals and non-metals. Through comparing pre- and post-test performances of students in control (chalk talk) and experimental (mind mapping) groups, the research aimed to determine significant differences in scores, using a significance level of 0.05 and formulating null hypotheses. The findings indicated a significant correlation between mind mapping implementation and improved performance, supported by theories like Radiant Thinking, Dual-coding, and Generative Learning. This underscores the potential of mind mapping to enhance comprehension and retention of Chemistry concepts among Junior High School students. The implications extend beyond Chemistry education, advocating for innovative teaching strategies aligned with educational psychology principles to foster critical thinking and lifelong skills. However, the study acknowledges limitations such as sample size and design constraints, suggesting avenues for future research to explore long-term effects, differential impacts across student populations, optimal integration with other approaches, and mechanisms underlying cognitive processes involved in mind mapping. Thus, while the study provides valuable insights, it also highlights the need for continued research to refine our understanding of mind mapping's role in enhancing student learning experiences across educational domains.

Funding: This research received no external funding.
Conflicts of Interest: The authors declare no conflict of interest.

References

[1] Anderson, J. R., & Bower, G. H. (1973). Human associative memory. Winston.
[2] Brunye, T. T., Taylor, H. A., & Rapp, D. N. (2008). Repetition and dual coding in procedural multimedia presentations. *Applied Cognitive Psychology, 22*, 877-895.
[3] Budd, J. W. (2003). Mind Maps As Classroom Exercises. Industrial Relations Landgrant Term Professor, Industrial Relations Center, University of Minnesota, March 2003.
[4] Buzan, T. (2002). How to Mind Map: The Ultimate Thinking Tool That Will Change Your Life. London.
[5] Buzan, T., & Buzan, B. (2006). The Mind Map Book. London: BBC Active.
[6] Edwards, S. (2010). Mind mapping as a teaching resource. Fourth-Year Medical Student at Peninsula Medical School, University of Exeter, Exeter, UK, Nick Cooper, Clinical Senior Lecturer, Peninsula College of Medicine and Dentistry, Plymouth, UK.
[7] Farrand, P., Hussain, F., & Hennessy, E. (2002). The efficacy of the 'mind map' study technique. Medical Education, 36(5), 426-431.
[8] Reed, S. K. (2010). Cognition: Theories and application (8th ed.). Belmont, CA: Wadsworth Cengage Learning.
[9] Rendas, A. B., Fonseca, M., & Pinto, P. R. (2006). Toward meaningful learning in undergraduate medical education using concept maps in a PBL pathophysiology course. Advances in Physiology Education, 30, 23-29.
[10] Sternberg, R. J. (2003). Cognitive theory (3rd ed.). Belmont, CA: Thomson Wadsworth.
[11] West, D. C., Park, J. K., Pomeroy, J. R., & Sandoval, J. (2002). Concept mapping assessment in medical education: A comparison of two scoring systems. Medical Education, 36(9), 820-827.
[12] Wittrock, M. C. (1990-1992). Generative learning processes of the brain. Educational Psychologist, 27(4), 531-541.