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The use of modified frayer model in developing science vocabulary of senior high school students

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Abstract

This study aims to investigate the use and effect of the Modified Frayer Model in enriching science vocabulary of Senior High School students. The design of this study is a randomized pretest-posttest control group design. The sample of this study is 60 Senior High School students of Quezon City Polytechnic University (QCPU). In both control (n=30) and experimental (n=30) groups, lessons in Earth Science were presented. Modified Frayer Model was used as instructional material in the experimental group. Independent sample t-test result showed that there is no statistically significant difference before the treatment. Paired sample t-test showed statistically significant difference between pretest and posttest scores for both control and experimental group. When posttest scores were compared, results revealed a statistically significant difference between the two groups. As conclusion, the use of the Modified Frayer Model in teaching science resulted in a significant improvement in science vocabulary of students.

Keywords: Frayer Model; science vocabulary; science education; instructional material.

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1. Introduction

Science education teach students on how to use scientific patterns to communicate information and to solve problems by means of writing or speaking about the issues in which science is relevant (Lemke, 1990). It is necessary for student to developed scientific literacy for him to be able to understand scientific concepts and processes which is required for in everyday activities such as problem solving, decision making or explaining natural phenomena. Scientific literacy can be fully achieved through learning and applying of scientific concepts in everyday real life situation. This is possible if the person has a great knowledge of science vocabulary which supports the development of scientific understanding (Nelson & Stage, 2007).

Wellington and Osborne (2001) pointed out that basically science teachers are likewise a language teachers. Science teachers able to demonstrate scientific thinking and questioning, including the uncertainties and problems that are part of making sense of the world through the use of scientific terms and phrases during the leaching and learning process. Without suitable vocabulary instruction, students are expected to experience a hard time in the learning the basic concepts for which they have previous information that seems to be not related to the subject being discussed (Wanjiru & O-connor, 2015). There is a need for a student to fully understand the meaning of important vocabulary words whether written or spoken in order for him to comprehend and converse ideas (Wanjiru & O-Connor, 2015).

According to Chall (1987) there are two general methods in teaching vocabulary, the direct teaching and meaningful context method (Chall, 1987). Chall (1987) stressed out that direct teaching of vocabulary leads students to give profound meaning to words. In most cases science lessons were teach in school by presenting science vocabulary words first to students and ask them to write the words and look for the meaning through dictionary or glossary of terms found in the textbook, or by means of matching words to its meaning, or by using the given words in a sentence (Naggy, 1988). In this instruction, scientific words are frequently presented in separation and students are tested on the words alone, without application to concepts (Irvin, 1990). As a result, this kind of practice has only little effect to the student's conceptual development (Irvin, 1990). These traditional strategies are rooted from the notion that students grasp the meanings of different scientific terms simply by writing and giving their definitions (Irvin, 1990). In addition, allotted contact teaching hours in schools is very limited which resulted to teachers find it challenging to include science vocabulary instruction to help students to understand scientific concepts presented in class or in a given text (Kragler, Walker, & Martin, 2005) and mostly teachers give priority to teach the content and end up giving a very small portion of the period in discussing science vocabulary.

Vocabulary instruction is effective when it includes visual, verbal, and physical support; therefore, physical scaffolding is critical in content-area teaching (Dunston, 1992). Teachers' uses of non-verbal gestures or graphic representations convey understandings of science concepts and are beneficial for all students, including culturally and linguistically diverse students (Best, Dockerell & Braisby, 2006). Modelling the use of vocabulary words through hand gestures and related to student's experiences throughout instruction reinforces the comprehension of students and maximizes instructional time (Rowe & Goldin-Meadow, 2009).

In addition, research supported strategies help build depth of vocabulary knowledge and promote word consciousness, by asking students to predict the meanings of words and compare it with other students and teacher can also strengthen the acquisition of knowledge (Harmon, Hedrick & Wood 2005). Interdisciplinary approaches that blend literacy lessons with science can also support science literacy (Harmon, Hedrick & Wood, 2005).

By means of hands-on inquiry instruction, student can develop context-based content knowledge together with language development. In other words, combined with science activities, intentional and explicit vocabulary instruction can benefit student's vocabulary and literacy development as they learn science content (Lee et al., 2009; Beck & McKewon, 2007). When a student combines science

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experiences with discussions of words' uses and meanings, his vocabulary and content knowledge grow (Lee et al., 2009; Beck & McKewon, 2007). In addition, when a student interacts with science words in multiple ways, he will be able to approach words and their meanings comprehensively. Graphic organizers can help to present words with a range of contextual information. This graphic organizer provides a template for presenting a vocabulary word with contextual information. Teachers use graphic organizers as classroom management tools for many reasons: They help students classify and organize their ideas, they help them construct meaning, as well as help students communicate more effectively.

One of the many strategies used to help students learn and use science vocabulary is the Frayer Model. Frayer Model was developed by Dorothy Frayer together with her colleagues in 1969 at the University of Wisconsin USA. This graphic organizer aids students in learning precise meanings of key concepts. This exceptional teaching strategy is widely popular and a staple in most classrooms. **Frayer Model** is a visual graphic organizer that helps students select and organize information related to a key concept. Its grid design is divided into four sections: Essential characteristics, nonessential characteristics, examples and non-examples. The definition goes in the top left square, characteristics in the top right square, examples in the bottom left square and non-examples in the bottom right square. The definition should be one the student develops rather than something copied from a dictionary or glossary. The characteristics of the term should be things that are essential. The examples and non-examples help push students' thinking about the term. The structure and thinking processes incorporated in this strategy provides an opportunity for students to build a deep understanding of the term (Roe & Smith, 2012).

One advantage of this strategy is that, students are active learners and are noticeably highly motivated. Students learn best through active involvement in learning new words (Roe & Smith, 2012). Consequently, students exposed to the Frayer model tend to go far beyond learning mere definitions of words; instead, they develop a far deeper understanding of concepts. As a result the use of the Frayer model increases the students' understanding of new vocabulary, and they show a deeper and more complex understanding of concepts (Cohen & Cowen, 2008). The process of stating a definition, describing characteristics and articulating examples and non-examples helps students develop a deeper understanding of a word than they might achieve from only a definition (Greenwood, 2010).

Meanwhile, 4 Pics 1 Word is a mobile application developed by RedSpell (iOS) and word puzzle game created by LOTUM GmbH which allows the user to enhance his vocabulary by means of identifying a certain word based on the theme represented by four pictures. To complete the word, the user will pick letters from the given jumbled letters. The player will advance to the next level if he correctly identify the word based on the theme of the given four pictures. This kind of mobile application enhance the vocabulary of the player through the use of pictures, according to Gardner (1991) there are seven distinct intelligences, and we learn the world through language, logical mathematical analysis, spatial representation, musical thinking, making things, understanding other individuals, and understanding of ourselves. This kind of mobile application cater the verbal-linguistic and spatial visual intelligences Over 150 million people from different ages who downloaded this app and received a 4.4 stars or ratings from its users (4pics1word-answers.com).

Literature and studies revealed the effectiveness of graphic organizers like the Frayer Model when it comes to vocabulary building and acquisition of concepts (Wanjiru & O-Connor, 2015; Roe & Smith, 2012; Griffin & Tulbert, 2006; Hawk, 2006; Hill & Flynn, 2006; Howard & Ellis, 2005; Hall & Strangman, 2002; Gagnon & Maccini, 2000). However, among the surveyed literature and studies, none of these conducted a study on the use of Four Pics One Word in teaching vocabulary and at the same time its integration to a graphic organizer such as Frayer Model an used as instructional material and formative assessment tool to develop students' science vocabulary and cognitive skills, which was the primary objective of this study.

2. Methodology

They study used is a randomized pretest-posttest control group design. The sample of this study is 60 Senior High School students of Quezon City Polytechnic University (QCPU). In both control (n=30) and experimental (n=30) groups, lessons in Earth Science were presented. Modified Frayer Model was used as instructional material in the experimental group. According to Fraenkel, Wallen and Hyun (2013) in a randomized pretest-posttest control group design two groups of subjects are used, with both groups being observed twice. In forming the groups, random assignment was employed and the observations are conducted at the time for both groups (Fraenkel, Wallen & Hyun, 2013).

Modified Frayer Model is a combination of the Four Pics One Word and a Frayer Model. The Modified Frayer Models used in this study were developed based on the topics under the unit of “Earth’s Processes” listed in the course outline prescribed by the Department of Education (DepEd). The developed Modified Frayer Models were then used as instructional material in teaching the basic scientific concepts behind Earth’s External and Internal Processes (see samples in figures 1 & 2). Experts were asked to evaluate the prepared Modified Frayer Models if they were suitable for Senior High School students and can be used in the teaching and learning process.

In determining the achievement of students before and after the experiment, a ten-item multiple choice teacher-made test was constructed. The test questionnaire was validated by two experts in the field of science education and piloted to ten senior high school students (which were not part of the actual experimental procedure) to test its reliability. The final test questionnaire has a reliability of 0.72 using Cronbach’s alpha test and considered as a valid and reliable test instrument.

The 10-item test was then used in the pre-test and post-test part. The pre-test was conducted before the start of the experimental procedure, and the posttest was given one week after the experimental procedure. Topics under the unit “Earth’s Processes” were presented in both control and experimental groups in four consecutive two hour classroom meetings for 2 weeks. The Modified Frayer Models were used as instructional materials in presenting the lessons and formative assessment tool in the experimental group, while in the control group received a regular lecture-discussion method of instruction. In order to analyze the result of the students’ achievement before and after the experimental procedure, paired sample *t*-test was employed to determine if there was a significant difference between the pretest and posttest scores in each group. And the pretest and posttest scores of students in different groups were compared through independent sample *t*-test at 0.05 level of significance.



Figure 1. Modified Frayer Model Student Worksheet

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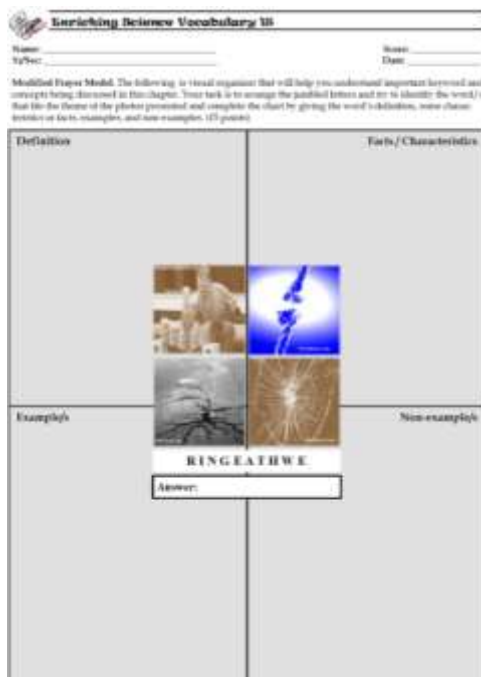


Figure 2. Modified Frayer Model Student Worksheet

3. Results and Discussion

Data were analysed by using Microsoft Office Excel 2007 Statistical Data Analysis Tool. Before analysing the data, all assumptions of the analysis were checked. Independent sample *t*-test was conducted to investigate if there is a significant difference between control and experimental groups. Results showed that the computed mean value of the two groups is 10.90 for control group and 10.77 for experimental group before the experiment are closely related with one another which denotes that the two groups shows homogeneity before the experiment, thus they are a good subject for the study. The computed *t*-value is 0.25 which is less than the *t* critical value with 57 degrees of freedom (df) at 0.05 level of confidence. In addition, the computed *p*-value is 0.81 which is greater than 0.05 level of confidence supporting the claim that there is no significant difference between the two groups before the experimental procedure (see Table 1).

Table 1. Independent Sample *t*-test of the Pre-test

Groups	N	Mean	SD	Df	t-value	p-value
Control Group	30	10.90	1.92	57	0.25	0.81
Experimental Group	30	10.77	2.24	57		

One week after the experimental procedure, both groups were given a post-test. Computed mean values between control group and experimental group are 13.10 and 14.80 respectively while the computed *t*-value (3.42) is greater than the *t* critical value with 58 degrees of freedom (df) at 0.05 level of confidence which denotes a significant difference between the two groups. In addition, the computed *p*-value is 0.00 which is less than 0.05 level of confidence supporting the claim that there is a statistical significant difference between the post-test of the two groups (see Table 2).

Table 2. Independent Sample t-test of the Post-test

Groups	N	Mean	SD	Df	t-value	p-value
Control Group	30	13.10	2.01	58	3.42	0.00
Experimental Group	30	14.80	1.85	58		

Paired sample *t*-test was conducted to investigate if there was any significant difference between pre-test and post-test scores for experimental and control groups with respect to their achievement. Results showed that the computed *t*-value for control group is 19.75 and 24.82 for experimental group which are greater than the *t* critical values at 0.05 level of confidence and denotes a statistically significant difference between the pre-test and post-test scores in both experimental and control groups. The claim was supported by the computed *p*-value for experimental ($p = 0.00$) and control ($p = 0.00$) which is less than 0.05 level of confidence respectively (see Table 3).

Table 3. Paired Sample t-test

Groups		N	Mean	SD	df	t-value	p-value
Control Group	<i>Pre-test</i>	30	10.90	1.92	29	19.75	0.00
	<i>Post-test</i>		13.10	2.01			
Experimental Group	<i>Pre-test</i>	30	10.77	2.24	29	24.82	0.00
	<i>Post-test</i>		14.80	1.85			

Graphic organizers such as the Frayer Model has a great impact to students in learning vocabulary (Wanjiru & O-Connor, 2015; Roe & Smith, 2012). It is one of the recent popular forms of graphic organizer and used as instructional material and formative assessment tool available in a variety of printed materials (Wanjiru & O-Connor, 2015; Roe & Smith, 2012; Griffin & Tulbert, 2006; Hawk, 2006; Hill & Flynn, 2006; Howard & Ellis, 2005; Hall & Strangman, 2002; Gagnon & Maccini, 2000). With the help of this organizer, student able to make connections between what they know and what they learn. In addition, researchers observed that the Modified Frayer Model promotes critical thinking and creates a visual reference to compare examples. The results of this study supported recent studies that vocabulary instruction is an important part of reading and language arts classes, as well as content area classes such as science and humanities (Griffin & Tulbert, 2006; Hawk, 2006; Hill & Flynn, 2006; Howard & Ellis, 2005; Hall & Strangman, 2002; Gagnon & Maccini, 2000). Clear vocabulary instruction can help students to learn the meaning of new words, increase their comprehension, and develop their ability to communicate effectively.

Integrating Modified Frayer Model in classroom instruction and use it as a formative assessment tool is far more effective in enhancing student’s science vocabulary and improving performance as compared to the traditional lecture-discussion method. Facilitating students to develop a strong vocabulary increases their ability to read, write, discuss, present, and think.

4. Conclusion and Recommendations

This study provides a meaningful information about the use and effects of a Modified Frayer Model in developing student’s scientific vocabulary. The results of this study support the claims of researches about the effect of Frayer Model in developing and improving student’s vocabulary. In addition, this study provides a significant finding on how the Modified Frayer Model helps and improves the teaching-learning process. As a conclusion, integrating the Modified Frayer Models in teaching as instructional material and formative assessment tool has a great impact in developing student’s

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scientific vocabulary and academic performances. A study on the validity and reliability of the Modified Frayer Model and developing an assessment tool for scoring are highly recommended.

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