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The Effects Of Concept And Semantic Webbing (Csw) On Achievement, Attitude And In Reducing Anxiety Towards General Chemistry

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ABSTRACT

This study showed how Concept and Semantic Webbing (CSW) promoted meaningful learning and lowers the level of anxiety in the field of General Chemistry, since the word "*chemphobia*" still exists within the corners of a Chemistry class. The more reducible in anxiety, the more meaningful learning happens. CSW helped students to make them feel comfortable in learning, anxiety will disappeared. Reducing anxiety gave students more chances to take risk and explore their learning actively. The results indicated that the use of CSW as a cognitive tool in reducing anxiety in General Chemistry produced a significant difference in academic gain and attitude scale for the students under the experimental group. The nature of students' learning must drive the type of performance used to assess students' knowledge. The products included in CSW are the outcomes of the students' academic performance and cognitive development.

Keywords : Concept and Semantic Webbing (CSW), General Chemistry, experimental and control groups, "*chemphobia",* cognitive tool

INTRODUCTION

In the past decade, concept mapping has become an increasingly popular educational activity in helping students study and analyze content domains. It has become so popular that, like the hemi-spherical lateralization brain research of the late 1970s, the rationales and results of concept mapping are being exaggerated and distorted by many researchers and teachers. The purpose of this action research is to briefly lay a conceptual foundation for using concept mapping as a cognitive learning strategy and as a method for assessing structural knowledge, and to investigate if it can alleviate the phenomenon called "*chemphobia*" inside the classroom.

Students' anxiety on learning science, specifically chemphobia makes them passive learners, which affects their academic performance. This produces more anxiety on learning and students might be able to do anything in this worst learning situation. Reducing anxiety is very important to give students the opportunity to express their ideas and learn actively.

Teachers are normally considered well-educated, legitimate, representative, and flexible members of our society. They are trusted to be responsible for the way students think and learn. Computer programs, which articulate, amplify, and consolidate certain aspects of students' learning, trigger a more fundamental and delicate discussion about the effectiveness and validity of the underlying view on human mentality. Apart from the optimization and validation of the current learning tools, it becomes an ever-increasing challenge to formulate new design rationales in designing the next generation of

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learning tools which gave birth to Concept and Semantic Webbing (CSW). Specifically, this investigation will seek to answer the following questions:

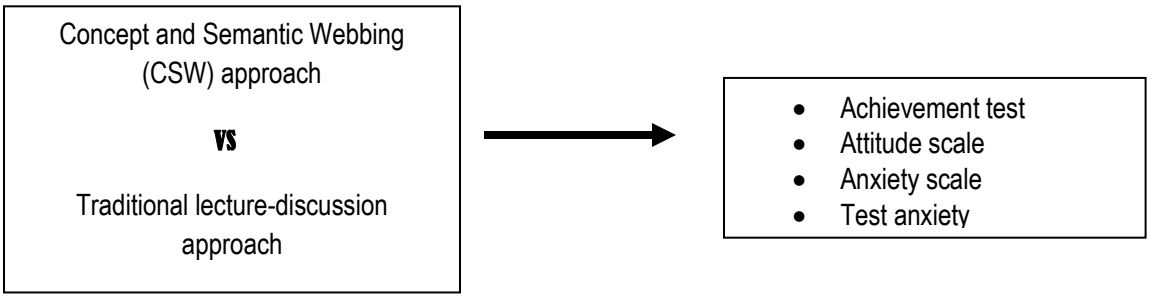
1. Is there a difference between the groups using CSW or the experimental group and the traditional lecture-discussion approach in terms of:
   a. Achievement test ; and
   b. Departmental exam?

2. How efficient are CSW as compared to traditional lecture-discussion approach in terms of :
   a. Attitude towards Chemistry ;
   b. Anxiety towards Chemistry ; and
   c. Test Anxiety?

3. What were the levels of anxiety between the two groups in terms of :
   a. Anxiety Scale and Achievement test scores ; and
   b. Achievement and Departmental Test Scores

The constructivist view of learning suggests that learners construct their own knowledge, strongly influenced by what they already know. In this way, learners build their own individual sense of 'reality'. Constructivism encourages educators to recognize their students' strongly held preconceptions and to provide experiences that will help them build on their current knowledge of the world. Social constructivism acknowledges that learning is a social activity in which learners are involved in constructing consensual meaning through discussions and negotiations. During these discussions, students can identify and articulate their own views, exchange ideas and reflect on other students' views, reflect critically on their own views and when necessary, reorganize their own views and negotiate shared meanings. Although individuals construct their own understandings, it is not done in isolation but in a social context (Esiobu & Soyibu,2005).

The conceptual framework of this study is based on constructivism, which refers to an inductive method of guiding students to discuss and organize ideas and process them. This statement implies that the nature of the environment is as important as the characteristic of the learner and that altering the environment may lead to different learning outcomes.



The diagram shows the method of instruction affecting the students' achievement, attitude and perception in General Chemistry. In the study, the experimental group and control group were subjected to two (2) different methods of instruction, the independent variable, in order to measure what is more effective in enhancing students' scientific learning.

METHOD

The data sources in this study which includes the Achievement test, Attitude test, Anxiety test and CSW which was used by the experimental group. The different concept and semantic webs were either made by students and by the teacher-researcher. It is made either in softcopy (in the

computer) or hardcopy (in the students' notebook). Both quantitative and qualitative data was analyzed to answer the questions posed in this research. The following research instruments were used in collecting data:

1. *Chemistry Achievement Test*
   This instrument was a teacher-made examination composed of 50 items covering topics on Mixtures, Compounds, Acid-base concepts, Types of Chemical Equations, Balancing REDOX Equation, and Stoichiometry. It was administered before and after the study.

2. *Departmental Examination in General Chemistry*
   This is a final exam given before the end of the semester in all sections taking up General Chemistry. It is usually prepared by the FEU General Chemistry Committee composed of professors in the Institute of Education under the Science Department. The type of questions varied from matching type, multiple choices, problem solving and paired analogy. The topics covered these from the beginning of the course until the last topic.

3. *Chemistry Attitude Scale*
   This was made by the researchers and it was field tested at FEU involving 10 students and it garnered a reliability index of 0.83. This is a ten (10) item of the Likert-scale type, wherein fifty percent as positive statements and the other fifty percent are negative statements. Its purpose is to measure the students' attitude in General Chemistry before and after undergoing the study. For the interpretation of the response in each statement, the following scores were used:

Mean Range	Verbal interpretation
4.21-5.00	Strongly agree
3.41-4.20	Agree
2.61-3.40	Not sure
1.81-2.60	Disagree
1.00-1.80	Strongly disagree

4. *Test Anxiety Scale*
   It consists of ten (10) items using the Likert scale type and was field-tested and scored a reliability index of 0.84. The purpose of this instrument is to measure the test anxiety level of students in both groups. The higher the score in this instrument, the lower was the test anxiety level and vice-versa.

5. *Chemistry Rubrics and Rating Scale*
   This instrument was adapted, edited and modified from a science rubrics scale (*www.101science.com/rubrics*). This was content was validated by experts regarding format, content and style.

A pretest-posttest experiment with random assignment of classes, for both experimental and control groups was employed to examine any possible treatment effect due to exposure to the concept mapping heuristic. After this, a matched-pair was formed, with achievement and anxiety as dependent variables. The aim was to examine the influence of anxiety towards achievement in General Chemistry through the use of different concept and semantic webs. First, the experimental group had time to familiarize with concept mapping strategy and was administered a pretest on anxiety and achievement.

The samples were two sections of first year college students of Far Eastern University. These students were enrolled in Chem1 or General Chemistry taking up either BS in Medical Technology, Psychology or Biology under the Institute of Arts and Sciences (IAS). The group leaders of each section were the major participants of this research paper since

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they are ones who collected, collated and edited the different concept and semantic webs done by their group members in the experimental group.

A pre-test Achievement test was given as a basis of matched-pair samples test was compared.

ANALYSIS OF RESULT

Table 1

Comparison of the Mean Scores in the Achievement test of the Experimental Group as Compared with Traditional Group

Achievement test scores	Mean score	Mean differences	Standard deviation	Computed t-values	Remarks*
Pretest					
Experimental Group	18.65	0.55	2.50	-0.71	**NS**
Control Group	19.20		4.59		
Posttest					
Experimental Group	30.15	5.00	2.40	3.57	**S**
Control Group	25.15		4.19		

**critical value at 0.05 level of significance at 19 degrees of freedom is 2.06*

The computed value of -0.71 is much lower than the critical value of 2.06 at 0.05 level of significance. Hence, the difference in the pretest score of the experimental and control groups is not statistically significant. Both groups started with the same knowledge and background in General Chemistry at the beginning of the study. The mean difference of 0.55 in the experimental and control groups indicated that the pretest scores were not varied in both groups.

In the experimental group, the mean score in the posttest is 30.15 with a standard deviation of 2.50. In the control group, the mean score in the posttest is 25.15 with a standard deviation of 4.19. The spread scores in the experimental and control groups were not varied as seen in the results of their standard deviations. Computing the t-test for independent samples, the computed t-value at 3.57 is higher than the tabular value at 2.06 at the 0.05 level of significance. This shows a significant difference between the posttest results of both groups in favor of the experimental group. Therefore, the students treated with concept and semantic webs performed better than the students who used the lecture-discussion approach in learning. The difference is attributed to the integration of different CSW which were either student-made or teacher-made in General Chemistry.

Based on the results, it is clear that one major advantage of CSW is that the experimental group was more actively involved in the learning process. With concept maps as guided by Rubrics scale, the instructional goals and objectives were met. The products included in CSW are the outcomes of the students' academic performance and cognitive development. Achievement depends upon students being taught the things on which they are being assessed, like a scoring Rubrics and

checklists. In this aspect, CSW can be used to remedy specific weaknesses in the student-learning learning process; since the purpose of the study is to determine how much did the students have learned from the instruction and in the material

.

Table 2

Comparison of the Mean Scores in the Departmental exam of the Experimental Group as Compared with Traditional Group

Departmental exam	Mean score	Mean differences	Standard deviation	Computed t-values	Remarks*
Experimental Group	37.60	4.65	4.51	2.72	**S**
Control Group	32.95		6.16		

**critical value at 0.05 level of significance at 19 degrees of freedom is 2.06*

The study showed that the experimental group had a mean score of 37.60 in the Chemistry departmental exam, which is higher by 4.65 than the score of the control group with 32.95. The difference had a computed t-value of 2.06, which was significant at the 0.05 level for 19 degrees of freedom. The experimental group were able to understand the basic concepts and principles behind each topic. Also the students in the experimental group remembered the essentials of chemistry concepts when they were guided during the course of the discussion.

In this research showed the positive effects on enhancing students' learning by using concept mapping. In study made by Wallace & Mintzes (2000), teachers tested a few organizer (like concept mapping, outline, no organizer) for enhancing students' learning and groups with concept mapping marked higher scores in the posttest than any other groups with the other organizer. The teacher noticed that concept mapping provided students with an active opportunity to explore their learning. This is a reflection of a student-centered learning by involving the students themselves in learning. Students are not passive subjects any more in learning if they use concept mapping as an advance organizer. Furthermore, teachers are not passive knowledge suppliers in teaching if they use concept mapping as an advance organizer. In another study made by Willerman & Mac Harg (2001), concept webbing was used as teaching method. A teacher taught students by providing concept mapping for helping students' learning and another teacher taught them by traditional method like the lecture as expository method. The former method is for meaningful learning and is students-centered while the latter one is for rote learning and teacher-centered. Retaining concepts in the former learning mode is longer and more powerful than the latter one. This means that showing concept mapping as a visual reference during lessons makes the students' learning more meaningful and fruitful. Visual references like technology provide students to learn and help teacher to teacher effectively. A third study supported the use of concept mapping in learning. Specially, this study provided a relationship between parts of concept mapping and students' achievements. It showed that words on map were not related to students' performance. Instead, the number of valid links made students' performance more positive. This implied that teachers and students must focus on relationship between concepts, not on concepts themselves in teaching and learning. If students

know the relationship between concepts, it is clear that this will make their learning meaningful. Also in the study of Stensvold & Wilson (2000), cross-link in concept mapping played an important role in students' learning. Research findings also showed significant results for students using concept mapping in their learning. Additionally, this study demonstrated that concept mapping proved performances in novel problem-solving tasks. And lastly, as reviewed by Newton (2007), it appeared that concept mapping offered a valid and useful mechanism for making students' learning more effectively.

The evidences from these studies including the result of this research showed that concept and semantic webs can be a very powerful mechanism in promoting students' meaningful learning and enhancing their achievement and performance. More study must be made to know how this new mechanism which be used more easily and effectively in the science classroom.

Today, many of the science teachers have little or no experience teaching students with diverse learning needs. Many are also not trained to meet the needs of these students who have little or no exposure to science. Regular and special education teachers rely on the textbooks and utilize direct instruction to teach science (Brophy & Good, 1996). The learning differences of these students may best be addressed by concept maps for teaching science subjects (Atwood & Oldham, 1995)

Table 3

Comparison of the Mean Scores in the Attitude Test of the Experimental Group as Compared with Traditional Group

Achievement test scores	Mean score	Mean differences	Standard deviation	Computed t-values	Remarks*
Pretest					
Experimental Group	33.70	1.32	0.39	0.98	**NS**
Control Group	32.38				
Posttest					
Experimental Group	39.29	3.86	0.50	1.02	**S**
Control Group	35.43				

**critical value at 0.05 level of significance at 10 degrees of freedom is 1.03*

The results pretest mean attitude of 33.70 in the experimental group and 32.38 in the control group posted a mean difference of 1.32. This difference in attitude is not significant at the 0.05 level of significance. This shows that both groups are comparable as far as their attitude towards the subject is concerned. The standard deviations of the scores of the experimental and control groups have a slight difference at 0.39

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and 0.50, respectively, meaning they are not varied from one another.

The posttest mean attitude score of the experimental group is 39.29 while in the control group, the posttest mean attitude score is 35.43. Computing the t-test for independent samples, the t-ratio of posttest attitude scores of both groups is 1.02, which is greater than the critical t-value (2.00) at 0.05 level of significance. This implies that there was a significant difference in the attitude towards chemistry of both groups after immersion in the subject. This difference was attributed to the use of concept and semantic webs in General Chemistry.

Table 4

Comparison of the Test Anxiety Mean Scores Between the Two Groups

Achievement test scores	Mean score	Mean differences	Standard deviation	Computed t-values	Remarks*
Pretest					
Experimental Group	63.40		2.08		**NS**
Control Group	61.30	2.1	6.82	0.98	
Posttest					
Experimental Group	79.30		2.55		**S**
Control Group	76.00	2.29	6.79	4.46	

**critical value at 0.05 level of significance at 10 degrees freedom is 1.03*

The data shows that there is no significant difference in the anxiety level of both groups in taking a test before the start of the study. But as the study progresses, the mean difference (2.29) shows a significant change in favor of the experimental group. This explains that the high mean score of 79.30 for the experimental group after the study, indicates a low anxiety level towards taking test as when compared with the control group.

On the other hand, before the start of the study, the mean score of the experimental group was less varied than the control group, as shown in the standard deviation of 2.08 and 2.55. After the study, both groups scores in the pretest and posttest score in the Test Anxiety scale in General Chemistry did not vary a lot.

Indicators of Validity and Reliability

In order to investigate the relationship between the existing "*chemphobia*", the post-Anxiety and post-Achievement test was compared using Pearson **r** correlation for its validity and reliability.

Table 5

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Correlation Between Anxiety Scale and Achievement test scores

Parameters	Experimental Group	Control Group
Mean score of the Post Chemistry Anxiety scale	38.00	39.65
Post mean score of the Achievement test	30.15	29.40
r_{xy}	0.04	0.50
Remarks*	**Very weak correlation**	**Moderate correlation**

**0.91-1.00=very strong correlation, 0.61-0.90=strong correlation, 0.41-0.60=moderate correlation, 0.21-0.40= weak correlation and 0.00-0.20 very weak correlation*

It indicates that there is very weak correlation between the Achievement test scores and external measures like Chemistry anxiety in favor of the experimental group. If given an external assessment such as standardized paper and pencil and teacher made tests, the experimental group were more willing to accept challenges that will involve problem solving and critical thinking. Generally, the experimental group using CSW showed high confidence and competent levels among students in the experimental group. The teacher-researcher suggests that when CSW are used in combination with standardized tests provides a better measure of the full range of multiple educational performances and of students' abilities and skills. Since learning is not reduced to a multiple-choice test or a single score, the combination of standardized test and concept maps portrays a more complete picture of learning.

While for the control group, there is a moderate correlation between post mean scores of Chemistry Anxiety and posttest Achievement. This explains why some of the students in the control group had fear and disinterest towards the subject. But it can be considered that a number of students are competent enough to take exams in Chemistry. Nevertheless, there is still a small significant little relationship between anxiety towards the subject and taking the Chemistry test.

The effectiveness of CSW is demonstrated through the increased academic, attitudinal and behavioral changes as shown from the results of the different instruments used in this action research. The teacher-researcher would also like to emphasize the following observations during the study about the impacts of CSW which includes: (a) an emphasis on the subject matter, (b) practice with decision-making and analytical strategies, (c) attention to relevant latest invention and breakthroughs, and (d) an emphasis on the applications of science. Other characteristics include emphases on cooperative work on real problem solving, multiple dimensions of science, and an evaluation based on the ability to get and to use information rather than simply to retain it.

Table 6

Correlation between Achievement and Departmental Test Scores

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Parameters	Experimental Group	Control Group
Mean score of the posttest Achievement	34.95	34.95
Mean score of the Departmental test	37.60	29.40
r_{xy}	0.70	0.07
Remarks*	**Strong correlation**	**Very weak correlation**

*0.91-1.00=very strong correlation, 0.61-0.90=strong correlation, 0.41-0.60=moderate correlation, 0.21-0.40= weak correlation and 0.00-0.20 very weak correlation

It also reveals that the mean scores of posttest Achievement and Departmental exam, which favors more on the experimental group with a correlation coefficient of 0.70, which was interpreted as strongly correlated. This means that the scores of the experimental group using CSW assisted the student's knowledge in General Chemistry. It helped them build contextual and cognitive evaluation of the subject matter. Since one of the goal of the teacher-researcher is to enable the students to relate the material in a purposeful way by using concept and semantic webs, so that the students can understand and apply knowledge. The teacher in doing this will facilitate a deep learning and holistic approach to the type of assessment and not just expository learning.

In connection to previous studies made by Glynn, Yeany, & Britton (2001), they reviewed that a lot of attention has being directed to understand how the learner learns and how to help him learn concepts to improve science achievement through more effective instructional strategies. The researchers added that the efforts in assisting the learner to learn have led to the development of the metacognitive strategies of learning about meaningful learning (Novak, et. al., 2008). Researchers in this study introduced CSW as a new tool for making students' learning meaningful and found some researches to support effectiveness of using this tool in the classroom. Since there were various studies on the interaction between anxiety and instructional methods with negative correlation between them, researchers recommended that CSW could be a possible means of reducing anxiety in the science classroom and hence enhancing meaningful science learning and achievement. Another issues in which researchers introduced in this study was about gender difference in their learning where boys tend to express greater leisure and career interests in science more than girls. In sum, It was hypothesized if: (1) The cognitive strategy of CSW reduces anxiety and thereby enhances achievement in other subjects; (2) Gender has any significant effect on students' anxiety towards the learning of science through the CSW strategy.

DISCUSSION

This study provided the teacher with empirical support for making and using the CSW as an advance organizer. Concept and semantic webs provide the teachers with guidance in how to show the relationship between important ideas in the lesson plans. This relatively simple device greatly contrasted with the complicated direction, definitions, and examples in textbooks for constructing and using advance organizers. However, teachers must know how to use necessary equipment like the overhead projection and multi-media projector to show how to construct concept map. Constructing concept and semantic webs also provided

students with cognitive structures that make their learning more meaningful and lasting.

For students' learning, researchers in this study suggested that student is not just a passive consumer of information and students themselves make meaningful learning happen. It was hypothesized that concept mapping succeeds in getting students more involved in how they learn. CSW gives them an active opportunity to integrate and synthesize new knowledge. If the concept map is an integral part of the course, students become interested and involved in discovering new relationships among concepts. The researchers suggested that teacher is not just a passive supplier of information and teacher himself inspires meaningful learning to take place. In addition to this, CSW succeeds in getting teachers more involved in how the students learn. The teacher becomes the stimulus and plans courses along links between concepts.

The researchers described that further research needs to be done using concept and semantic webs as an advance organizer in other disciplines and areas, over longer periods of time, and with larger samples of students in order to obtain better data.

References

Atwood, R. K., & Oldham, B. R. (1995). **Teachers' perceptions of mainstreaming in an Inquiry oriented elementary science program**. *Science Education,vol. 69.*

Brophy, J., & Good, T. L. (1996). **Teacher and student achievement in learning science.** *The third handbook of research on teaching*. New York: Macmillan.

Esiobu, G. O., & Soyibo, K. (2005). **Effect of concept and Vee mappings under three learning modes on students' cognitive achievement in ecology and genetics.** Journal of Research in Science Teaching vol.32.

Glynn, S. M., Yeany, R. H., & Britton, B. K. (2001). **A Constructive view of Learning science**. In S. M. GlyT~n et al., (Eds.), The Psychology of learning science. Hillsdale (NJ): Lawrence Erlbaum Associates.

Novak JD. (2008). ***Learning, Creating and Using Knowledge: Concept Maps as Facilitative Tools in Schools and Corporations***. Mahwah, NJ: Lawrence Erlbaum & Associates.

Newton GD. (2007). **Investigation of the effects of concept mapping on student problem solving performance when used as an adjunct to guided design**. *Am J Pharm Edu*cational Journal vol.23.

Stensvold, M. S., & Wilson, J. T. (2000). **The interaction of verbal ability with concept mapping in learning from a chemistry laboratory activity**. Science Education, vol. 74.

Wallace, J. D. & Mintzes, J. J. (2000). **The concept webs as a research tool: Exploring conceptual change in biology**. Journal of research in science teaching, 27.

Willerman, M. & Mac Harg, R. A. (2001). **The concept map as an advance organizer**. Journal of Research in Science Teaching, 28.

Websites reference:

Concept maps in Chemistry.*http://www.conceptmap/cm.3htm* .Retrieved last Jan 2012.

Semantic webs in Chemistry.http://www.wcer.wisc.edu/nise/cl1 (National Institute for Science Education). Retrieved last Jan 2012.

Rubrics in Chemistry.http://www.101science.com/rubrics/Chemistry.htm . Retrieved last Jan 2012.