

# COLLABORATIVE INSTRUCTIONAL STRATEGY AND SECONDARY SCHOOL STUDENT' CHEMISTRY RETENTION TESTS

Bika, M. Joseph<sup>1</sup>

GDSS Shangui

Post Primary Schools Management Board, Yola

Adamawa State, Nigeria.

E-mail: josephbika53@gmail.com

Phone No.: +2348026926897; 08141861806

Sule, Aldutsitiya<sup>2</sup>

College of Education

Hong, Adamawa State

Nigeria.

E-mail: lutsisuwartu@gmail.com

phone No: +2348062598340

## ABSTRACT

This study determined the effect of collaborative teaching strategy on chemistry secondary school students' post and retention tests in Adamawa State. The sample for this study consisted of 114 subjects selected from population of 3543 SSII chemistry students in 118 public secondary schools. The sampling involved stratified purposeful and random sampling techniques. Instrument for this study was tagged chemistry achievement test (CAT) developed by the researcher. The instrument was validated by three experts and a reliability coefficient of 0.85 using K-R 20 formula was obtained. This study adopted quasi- experimental design which involves a pretest post-test non-equivalent control group design. The design consists of one experimental group and one control group. The experimental group received treatment of collaborative teaching strategy, while the control group was with lecture teaching method; both for 6 weeks. Three null hypotheses were tested using Analysis of Covariance at 0.05 level of significance. From the analysis, the following major findings were obtained: there is significant retention of what have been learnt by the students in chemistry when taught using collaborative teaching strategy. There is significant gender difference in retention when taught chemistry by collaborative teaching strategy. There is no statistical significant interaction effect of gender difference and collaborative teaching strategy on retention of chemistry concepts by students. Based

on these findings, it is recommended that teachers should use collaborative teaching strategy to teach chemistry so as to increase retention of learned materials thereby improving their Senior Secondary Certificate Examination results.

**Keywords:** Collaborative, teaching strategy, lecture teaching method, gender, post-test, retention test and students' achievements

---

## Introduction

The importance of chemistry in the development of any nation cannot be underrated especially in Nigeria where the national income rests on petroleum and petro chemical industries [1]. However, the performance or achievement of students in chemistry at credit level has been below 15.4% as from 2004 to 2007 at Senior Secondary Certificate Examination level [2]. This situation is of concern and needs to be addressed. To address the situation, researchers such as [1], embark on a study in which they found that methodology or strategy of teaching plays a very vital role during teaching-learning situation. The method or strategy adopted by the teacher may enhance or hinder learning.

Despite the fact that there are several methods and teaching strategies, the adoption of lecture method by most teachers at secondary school level is common. The teachers adoption of lecture method may be in order to cover

the bulky chemistry curriculum before SSCE, and this affect students' performance [2] because researchers believed that lecture method is teacher centered only, hence pupil centered activities for developing scientific reasoning skills and processes are lacking. These activities (pupil centered activities) may be obtained in collaborative teaching and learning strategies [3], which are a strategies where teachers and students collaborate and stand against the competitive system in a traditional method [4], [5].

Lecture method of teaching is said to be the oldest method of teaching, which is based on the philosophy of idealism. This means refers to explanation of contents of task to students by teacher and the students individually try to understand the teacher's explanation of the content through gesture, simple devices, changing voice, change in position and facial expression. The teacher is always more active and the

students are passive. However, the teacher asks students questions to keep them attentive in the process [6]. [7] defines lecture method as a process of transmitting knowledge or information from a teacher to a large number of students spontaneously. This knowledge transmission does not allow learners to interact which may lead to forgetfulness of the knowledge acquired within short period, hence leading to poor performance in examination conducted after the short period of time.

Collaboration is to team up to solve a particular problem at hand. The teaming up can be in small groups or larger groups depending on how the collaborators want it done. [4] reported that collaborative learning is an instructional strategy in which students team up together on a given instructional objectives either in form of assignments or class discussions and the teacher being a guide. [4], Fall cited in [8] and [9] explain that collaborative learning is also collaborative teaching strategy, hence can be used interchangeably.

[4] stressed that collaborative strategy in instruction involve various activities such as case studies and discussions. This discussion can be

student- moderated discussion, debates, collaborative writing, collaborative presentation, demonstrations, and so on. [10] defined collaborative strategy as the mutual engagement of participants in coordinated effort to solve a problem together. [11] puts it as a situation in which two or more people learn or attempt to learn something together under the influence of a teacher as a guide. Roschelle in [11] frames collaborative as an exercise in convergence or construction of shared meanings and notes, that research on conversational analysis that enable participants to reach convergence through construction, monitoring, and repairing of knowledge. From the foregoing definitions of collaborative instruction, one can deduce that it is an instruction in which intellectual knowledge sharing occurs. And in this case, the learners being actively involved may not easily forget what they have learnt.

As a result of shortcomings of the lecture instruction that leads students to easily forget what they learnt, Mari and Okebukola in [1] in their study have called for change from lecture method of teaching chemistry to teaching methods or strategies that involve students

actively. The lecture method is not convenient for teaching topics perceived to be abstract and difficult as pointed out by [12]; that there are 13 topics out of 20 major topics in the secondary school chemistry curriculum that are perceived to be abstract and difficult (oxidation and reduction, electrolysis, and so on) to secondary schools students. The 13 topics constitute 65 percent of the topics in the chemistry curriculum. Now that majority of the topics are abstract and difficult; there is need for teaching strategy that can create active environment for learning to take place.

Collaborative teaching and learning among teachers and students is to construct meaning, solve problems and so forth collaboratively. [13] reported that students taught using collaborative teaching strategy may perform better than students taught by traditional method of teaching. He further stressed that most students benefit more from working in collaboration than individually; and re-emphasized that in collaborative teaching strategy, sharing of ideas by students, talking and listening to each other, clarification of ideas and team work enhance better achievement. [14] also stressed that students working in groups

can be introduced to new information to clarify their conflict or to attempt to explain and justify their own position and the result is improve learning. In addition, students working together collaboratively under guidance can generate new approaches to solve problems that none of them knew prior to working together.

Students' achievement in chemistry is becoming a state of concern as revealed by [2]. He reported that achievement of students in chemistry in Senior Secondary Certificate Examination from 2004 to 2007 was below 15.4%. [15] in support of this reported that the result of West Africa Examination council (WAEC) in chemistry for Adamawa state in 2014 West Africa Secondary Schools Certificate Examination is below 10%. Hence, there is need for more research to be conducted to solve the problem of low performance by the students in chemistry.

Retention is the ability of the students to recall after three or more weeks of learning, what they have learnt in past times. [16] reported that chemical principles have low retention rate by the students. As a result, it is one of the subjects students use to fail in examinations or tests, especially when the

tests or examinations are conducted after long time of learning it. Contrary to report by [16], [17] stated that the rate of forgetfulness among students in learning chemistry ranges from 15% through 18%. The low percentage shows that students' retention is high, ranging between 82 and 85%. In disagreement to [17], [18] in a study revealed that always before he starts a course titled 'chemical bases' with students, the students were asked "who have studied acids and bases in chemistry before?" Almost every hand used to go up, but when the students were told to keep their hands up if they still understand acid and base in chemistry, only about 10% of hands will be seen up. This situation meant, the students have forgotten what they learnt; hence cannot claim to understand. [19] from a study on the other hand discovered that students taught using modular cooperative teaching/learning strategy have high retention than those taught through traditional method of teaching. Another study by [13] showed that retention by student was higher using discussion method of teaching than lecture method of teaching. [20] in their study discovered that collaborative teaching strategy can

increase retention in addition to better performance.

Gender is another factor that has been disputed to be affecting achievement in science and chemistry in particular. Achievement test results over the years have shown an ever increasing gap between the performances of boys and girls in chemistry at secondary school level [21]. In line with [21], Greenfield in [21] also reported a significant difference between the performance of male and females in favor of males. Although [22] and [23] found a statistical significant difference between male and female performances, it is to the favor of female. [14] and [24] however disagreed with the findings of Greenfield and reported that there is no significant difference between the achievement of male and female in chemistry. These reports however may not be enough to establish an increasing or no increasing gap between the performances of males and females in chemistry at secondary school level. This is because the differences between males' and females' performances reported did not consider retention of the learnt concepts to certain extent. Also, those reported to have no significant difference might be due to the teaching strategies or

methods used. If another method or strategy is used the result may change and there are no significant reports on retention. Therefore, there is a need for more researches on retention in chemistry using collaborative teaching. Hence, that is the intention of this study.

### **Statement of the Problem**

The importance of science, especially chemistry in the technological development of a nation cannot be over emphasized [25]. However for many years now, there seems to be a trend in the performance of students in chemistry at secondary school level, particularly public secondary schools [26]. This low performance was revealed by [2], who reported that students' achievement in chemistry in Senior Secondary School Examination (SSCE) from 2004 to the year of his research was below 15.4%. In support of that, a report by [15] revealed that the result of West African Examination Council (WAEC) in chemistry for Adamawa state in 2014 WASSCE is below ten percent including chemistry at secondary school level. This unexpected situation prompted [1] to embark on a research on the causes of the low performance or achievement by the students. The result of their research

reveals that teaching method adopted by most of the teachers could be responsible for the low performance.

In agreement, [27], [28] and (2011) [29] stressed that majority of chemistry teachers adopt lecture method, hence resulting to students low performance. The researchers then suggested that there is a need to adopt other teaching methods or strategies that will actively engage students. In line with this, [30] presented some weaknesses of lecture method of teaching as follow: students who have strong learning style other than auditory learning will have a harder time being engaged in a lecture as the lesson will be too boring, which lead to lose of interest by the student and finally perform low. Some students who are weak in notes taking skills have trouble in understanding what they should remember from lectures. Besides, [27], [28], and [30] have advised teachers to use students centered teaching strategies or methods to teach chemistry. [31] and [29] have further stress that such teaching strategy can be collaborative teaching strategy since collaborative teaching strategy comprises of activities that are student centered as advised. The researchers however had neglected the

area of whether students retain what they learnt up to the period of SSCE or not. Therefore, the researcher would like to determine effect of collaborative teaching on retention.

### Purpose of the Study

The purpose of the study was to determine the retention of chemistry concepts by students when taught by collaborative instructional strategy. Specifically, this study determined

- i. Retention of learnt concepts in chemistry by students taught by collaborative instruction.
- ii. Retention of learnt concepts in chemistry by male students taught by collaborative instruction
- iii. Retention of learnt concepts in chemistry by female students taught by collaborative instruction

### Null Hypotheses.

The following null hypotheses were formulated in order to achieve the above mentioned purposes.

**H<sub>0</sub> 1:** There is no statistical significant difference between secondary school students' chemistry post test and retention test mean scores when instructed by collaborative instruction.

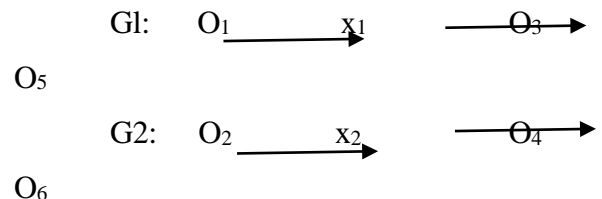
**H<sub>0</sub> II:** There is no statistical significant gender effect on school students'

chemistry post test and retention test mean scores when instructed by collaborative instruction.

**H<sub>0</sub> III:** There is no statistical significant interaction effect of gender and tests on secondary school students' chemistry mean scores when instructed by collaborative instruction.

### Methodology

The objective of the study is to measure the effect of collaborative strategy of teaching chemistry on students' academic achievement retention in Adamawa State public secondary schools. The study adopted quasi- experimental design which involves a pretest post-test non-equivalent control group design represented symbolically as follows:



G1 = Experimental group , G2 = Control group

Where: O<sub>1</sub> and O<sub>2</sub> are pre-tests of G1 and G2 respectively,

O<sub>3</sub> and O<sub>4</sub> are post-test of G1 and G2 respectively.

O<sub>5</sub> and O<sub>6</sub> are retention test of G1 and G2 respectively..

$X_1$  is the treatment for experimental G1 taught with collaborative teaching strategy and  $x_2$  is the treatment for G2

The sample for the study consists of 114 subjects from intact classes of the two secondary schools selected for the study. The sample consists of 64 male and 50 female subjects. The sampling method adopted was stratified random sampling and stratified purposive sampling technique. Instruments that were used for this study are two Chemistry Achievement Tests (CATs) constructed by the researcher. Originally, it was one instrument used for post-test which was reshuffled and used for retention test after three weeks of post-test administration. The instrument reliability is 0.85, indicating that it is appropriate for the study, determined by split half method. The achievement tests consist of 30 test items drawn from three topics (reduction reaction, oxidation reaction and

electrolysis) that were taught to both the groups by the researcher.

The experimental group was taught by collaborative teaching strategy, while lecture teaching method was given to the control group. After these treatments the groups, post-test was administered immediately to both the group. After three weeks, retention test was administered also to both the groups. The scores obtained from the post-test and pretest served the data for this research, which were analyzed by One Way Analysis of Variance. The ANCOVA result was conducted at 0.05 level of significance.

### Results

The results of the One Way Analysis of Variance to test the null hypotheses were reported in accordance with how they are stated is as below.

**Hypotheses 1:** There is no statistical significant difference between secondary school students' chemistry post test and retention test mean scores when instructed by collaborative instruction.

**Table 1. Descriptive Presentation of Results Analysis.**

Tests	Means	S. D	N
Post-test	27.79	6.39	56
Retention	25.61	6.36	56
Posttest and retention differences	2.18		



Male post-test	30.67	5.74	33
Female post-test	23.91	4.89	23
Gender posttest mean differences	6.76		
Male retention test	26.79	5.43	33
Female retention test	23.65	7.07	23
Gender retention mean differences	3.14		
Male posttest and retention differences	3.88		
Female posttest and retention differences	0.26		

**Table 2. One Way ANCOVA Test of Between Subjects Effects for Retention and Gender Interaction.**

Source	Type III sum of square	df	Mean square	F	P	Partial eta
Corrected model	914.400	4	228.600	6.758	.000	0.202
Intercept	6242.639	1	6242.639	184.557	.000	0.633
Pre-test	2.613	1	2.613	0.077	.782	0.001
Tests	88.704	1	88.704	2.622	.108	0.024
Gender	663.622	1	663.622	19.619	.000	0.155
Tests * gender	116.132	1	116.132	3.433	.067	0.031
Error	3619.279	107	33.825			
Total	84356.00	112				
Corrected total	4533.679	111				

R Square = .202 (Adjusted R squared = .172). \* Significant at  $P < 0.05$ .

From Table two, the p value at df (1, 112) and 0.05 level of significance = 0.108. Partial eta is 0.024. This indicates that the P value is greater than the significance level. Hence the null hypothesis is not rejected, meaning the

post-test and the retention tests mean scores are not quite different from each other. Table one is in agreement with non rejection of the null hypothesis. The posttest and retention mean differences of 2.18 in Table one is statistically

insignificant. Therefore, there is significant retention of what is learnt from collaborative teaching strategy.

**Hypotheses II:** There is no statistical significant gender effect on school students' chemistry post test and retention test mean scores when instructed by collaborative instruction.

The same Table two also reveal that P value at df (1, 112) and 0.05 significant level = 0.000. The P value of  $0.000 < 0.05$  (level of significance). Partial eta is 0.155. Therefore, the null hypothesis is rejected, which support a significant gender effects on the tests using collaborative teaching strategy. Table one is in support of this because both the mean differences of posttest and retention test shows differences in gender achievements.

**Hypotheses III:** There is no statistical significant interaction effect of gender and tests on secondary school students' chemistry mean scores when instructed by collaborative instruction.

For interaction effects in Table two, P value at df (1, 112) and 0.05 level of significance = .067. Partial eta is 0.031. Since the p value is greater than the level of significance, the null hypothesis is not rejected meaning that

there no interaction effect of gender and collaborative teaching strategy in chemistry on students mean achievements.

### Discussion

This study's finding that there is statistical significant retention of what has been learnt by the students using collaborative teaching strategy is in disagreement with a study by [16] and [18] who discovered low retention ability in chemistry by students using collaborative teaching strategy. The results of the study is in support of studies by [13], [19] and [17] who discovered high retention by experimental group using discussion method of teaching for the experimental group in chemistry; and discussion is part of the learning activities involved in collaborative teaching strategy.

Influence of gender on students' retention mean academic achievement was also obtained in favour of female students taught chemistry using collaborative teaching strategy. The mean differences from table one in academic achievement of post-test and retention mean scores is only 2.18 and for male and female students are: 3.88 and 0.34 respectively. While the P-value at df (1,

112) = 0.000, less than the level of significance, the null hypothesis is rejected. The rejection of the null hypothesis is in favour of female students because the mean differences in the post and the retention tests for female students is less than that of male students. Despite the fact that female students have higher retention ability than their male students' counterpart, the male students' retention scores were higher than that of female in both post-test and retention tests. This is in support of [21]. In disagreement, [14] and Adesiji and [24] emphasized no gap differences.

The high performance of male in the retention mean scores is not in support of studies by [32] and [1] which revealed no significant statistical difference between mean scores of male and female students. Result of this study is contrary to [23] who in their research on relative effectiveness of cooperative and competitive approaches to learning and teaching reported that females perform significantly better than males; and they are supported by [22]. This is because although female students are better in term of retention, the male students' mean scores are higher than their female counterparts. In agreement

with this study, other researchers who found that male students perform better than female students in the physical science subjects include: [33] and [34].

According to this study, collaborative teaching strategy is effective in increasing mean academic achievement of male students both in post test and retention. However, they may not retain all of what they have learnt for certain period of time as compared to female students. This study as seen from the discussion disagrees with other prior researchers and agrees with others. This situation may be as a result of physiological factors such as ages of the subject used, academic ability of the subjects used, and so on. The differences and the similarities could also be as a result of socio-cultural factors such as cultural differences, regional differences; religious believe and practices, attitudes, and so on. All these can be the results especially the differences since no enough prior study was found on the study area with similar topic.

### **Conclusion**

In conclusion, this study encourages teachers to use collaborative teaching strategy in teaching chemistry. This will enhance the students' achievements and

retention of learned task, which can enable the chemistry secondary school students to credit the subject in Senior Secondary Certificate Examinations. The knowledge also can be put to practice in industries and similar work places after graduation.

## References

1. Ameh, P. O. and Dantani, Y. S. (2013). Effects of lecture and demonstration methods of teaching on the academic achievements of students in chemistry in Nassarawa Local Government in Kano state. *International Journal of Social Sciences*. 1(1), 29-37.
2. Njoku, Z. C. (2007). Comparison of students' achievement in the three categories of questions in SSCE practical chemistry examination. *Journal of Science Teachers Association of Nigeria*, 42(1), 67-72.
3. Derek, C. (2007). Students attitude toward chemistry lessons: the interaction effect between grade level and gender. *Journal of Educational research*. 2(5), 157-168.
4. Diaz, V, Brown, M. and Salmons, J. (2010). Collaborative teaching and learning strategies, Educause. Learning initiative. Retrieved April 21st, 2008; From: <http://www.creativecommons.org/licenses/by-nc-sa/3.0/>.
5. Ranee, K. B. (2012). A definition of Collaborative Learning. Bright Hub Education Incorporation. Pennsylvania. 11-13.
6. Sharma, M. (2012). Lecture Method/Teaching Method. Gurukpo. India (article).
7. Hole, A. (2014). Teaching and learning development. *Teaching Modes and Methods*. University of Sussex. U.K. 2-3. Retrieved 5<sup>th</sup> August, 2014; from: <http://www.lectureteachingmodeandmethods>.
8. Rashid, S. and Gokhale, A. A. (2011). Collaborative learning enhances critical thinking. *Journal of Technology Education*. (7). 1, 123-135. Retrieved 17<sup>th</sup> December, 2014; From: <http://scholar.lib.vt.edu/ejournals/JTE/v7n1gokhale.jte-v7n1.htm>
9. Educational Broadcasting Corporation (2004). What are cooperative and collaborative learning? Concept to Classroom. 1 Article. Retrieved 17<sup>th</sup> December, 2014; From: <http://www.thirteen.org/edonline/concept?class/coopcollab/>
10. Lai, E. R. (2011). Collaboration: a literature review. *Pearson research report, Always learning*. Accessed: April 29<sup>th</sup>, 2014; from: <http://www.pearsonassessmnets.com/research>.
11. Dillienbourg, P. (1999). What do you mean by collaborative learning? In P. Dillienbourg (ed). *Collaborative-learning, cognitive and computational approaches*. Oxford press, Elsevier. 1-19.

12. Jimoh, A. T. (2004). Perception of Difficult Topics in Chemistry Curriculum by Students in Nigeria Secondary Schools *Ilorin Journal of education*, 1 (2), 112-125.
13. Abdul-raheem, B. O. (2011). Effect of discussion method on secondary school students' achievements and retention in social studies. *European Journal of Educational Studies*. 3(2), 293-301.
14. Williams, M. (2009). Effect of collaboration versus traditional instruction. *A Classroom Research*. Retrieved 15<sup>th</sup> September, 2014; from: [WWW.cisco.com/go](http://WWW.cisco.com/go).
15. Ilozue, C. (2014). Nigeria: Again Anambra Tops in WASSCE, Scores 65,92 percent. Retrieved November 11<sup>th</sup> 2014; from: <http://m.allafrica.com/stories/20140904126.html/>
16. Kartie, C. A. and John, D. S. (2010). Enhancing students' Learning and Retention With Blended Learning Class Guides. *Educause Review*.
17. Linsey, R. V, Jeff, D. S, Pashler, H. and Micheal, C. M. (2013). *Improving Students Long Term Knowledge Retention Through Personalize Review*. University of Colorado.
18. Roche, V. F. (2007). Improving Pharmacy students Understanding and Long Term Retention of Acid Base Chemistry. *American Journal of Pharmaceutical education*. 71(6), 122-133.
19. Espinosa, A. A. (2009). Comparative Efficiency of Modular method in the teaching of high school chemistry. *Methods in Educational Research college of university of Philistines, Diliman*. Retrieved October, 27<sup>th</sup> 2009: From: [http://www.isec.ac.iu./A\\_Comparative\\_study\\_of\\_effectiveness\\_of\\_modular\\_of\\_teaching\\_archive](http://www.isec.ac.iu./A_Comparative_study_of_effectiveness_of_modular_of_teaching_archive).
20. Berg, R., Hartman, J. and Toksvang, N. (2015). Collaborative Strategy Lead to Retention of Skill in Acid-Base Physiology. *Federation of American Societies for Experimental Biology Journal* 29(1). Retrieved 19<sup>th</sup> may, 2015; from: <http://www.fasebj/content/29/1/supplement/541.20.short>.
21. Onekutu, A. (2002). Gender difference in achievements in junior secondary schools examination in integrated science: implication for National Development. In O. O. Okpeh (ed). *Review of Gender Studies in Nigeria*, 170-173.
22. Igboegwu, E. N., Nwafor, O. and Okonkwo M. (2012). Influence of Gender and Location of School on Students' Achievements in Chemistry. *Journal of Research in Education*. 1(1), 118-123.
23. Abdullahi, A. and Duyilemi, B. O. (2009). The relative effectiveness of cooperative and competitive teaching methods in the teaching of biology at senior secondary school level. *Journal of Education and practice* 2(4), 210-225.
24. Adesoji, F. A. and Babatunde, A. G. (2005). Express teaching behaviour. Bridging the gender gulf in secondary school chemistry

- achievements. *International Journal of Africa and African-American studies*. 4(1), 54-61.
25. Adesoji, F. A. and Olatunbosun, M. S. (2008). Student, teacher and school environmental factors as determinants of achievement in senior secondary school chemistry in Oyo state. [electronic version]. *Journal of international Social Research*. 1(2).
26. Eriba, O. J. and Ande, S. (2006). Gender difference in achievements in calculating reacting mass from chemical equations among secondary school students in Makurdi metropolis. *Educational Research and Reviews* 1(6), 170-173.
27. Ezeliora, B. (2004). Motivating Science Secondary School Teachers to Face the Chalanges of the Third Millennium. *Journal of Teachers Association of Nigeria*. 39(1&2), 82-88.
28. Okoli, J. N. (2006). Effect of investigative Laboratory Approach and Expository Method on Acquisition of Science Process Skills by Biology Students of Different Levels of Scientific Literacy. *Journal of Science Teachers Association of Nigeria*. 41(1&2), 79-88.
29. Obamanu, B. J. and Ekenobi, T. N. (2011). Analysis of learning outcomes in chemistry among SSIII students in urban and rural area setting, using concept mapping technique. *Journal of Education and Practice*. 2(4), 148-154.
30. Kelly, M. (2014). Lecture Pros and Cons. *About.com Secondary School Education*. Accessed: April 29<sup>th</sup>, 2014; from: [Http://www.LectureasaTeachingMethod-ProsandConsofLecture2.html](http://www.LectureasaTeachingMethod-ProsandConsofLecture2.html).
31. Decanto, D. I, Ramirez, M. M. S, Aspee, M and Irma, S. (2006). Concept maps. An essential tool for teaching and learning to learn sciences. *Focus on learning problems in mathematics*. Retrieved April 21st, 2008; from: <http://www.Encyclopedia.com/doc/IGI-160922508.html>.
32. Akbas, A. and Kan, A. (2007). Affective factors that influence chemistry achievements (motivation and anxiety) and the power of these factors to predict chemistry achievements-11. *Journal of Turkish Science Education*. 4(1), 10-19.
33. Clark, C. and Gorski, P. (2002). Multicultural education and the digital devices. *Focus on Gender Multicultural Perspectives*. 4 (1), 35-40.
34. Ferguson, D. (2002). Project examines gender equity in math instruction. [electronic version]. *Curriculum Administrator*. 36 (90), 20-25.