EFFECTS OF BRAINSTORMING ON STUDENTS' ACHIEVEMENT IN SENIOR SECONDARY CHEMISTRY

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Abstract

The study investigated effects of brainstorming strategy on senior secondary students' achievement in chemistry in zone 'B' educational area of Benue state. One hundred and fifty six senior secondary 2 chemistry students randomly drawn from four schools formed the sample for the study. Two schools each were randomly assigned to experimental and control groups. Four research questions and four hypotheses were generated and tested. The brainstorming strategy was used as treatment for the experimental group while the lecture method was used for the control group. A validated chemistry Achievement Test (CAT) was used to obtain data. The descriptive statistics of mean, standard deviation and t-test were used to analyse the data. The result showed that students taught using brainstorming strategy achieved significantly higher than those taught using lecture method. The study recommended the adequate training of teachers on how to use brainstorming strategy for classroom instruction.

One of the fundamental achievements of education is to enable students to use their knowledge in problem solving. It has been observed that students do not solve problem at wanted level of proficiency. To help improve the learning and teaching of chemistry to enhance problem solving among students, science educators have agitated for the use of active-learning strategies which are learner centred.

Chemistry, one of the major science subjects has various applications in the home and industry. There is an increasing impact of growing knowledge in the subject- chemistry on social and economic life (Ohodo, 2005). However, the poor chemistry foundation at the secondary school will jeopardize any future effort to enhance achievement in the subject. It is expected that study of chemistry at the secondary school level should help students in developing some basic skills, knowledge and competence required for problem soloing in the environment. This is because such skills, knowledge and competence acquired will arouse students' critical thinking required for dealing with everyday life situations.

The persistent poor achievement in science subjects (chemistry inclusive) at senior secondary school level has given rise to an assumption that most teachers in secondary schools probably do not make use of some stipulated contemporary teaching strategies that will make them cope with the challenges of teaching and learning of science (Achor, 2003; Umoren & Aniashi, 2007; Ogbeba, 2009).

Experience and researches (Oyedokun, 1998; Awotua-Efebor, 1999; Timber lake, 2002) have shown that chemistry teachers adopt instructional strategies that are mainly teacher-directed which do not encourage active students' involvement and self regulation. According to Kupier (2002), self regulated learners are self – propelled and independent learners, who possess relevant skills on their own and realize that learning is a personal experience that requires active and dedicated participation. This perception of the role of the learner is changing

the views of educational researches on the role of teachers in the learning process.

Even though there are teachers with high morale, motivation and a mastery of knowledge, learner difficulties and capacity to facilitate learning are still important (Grauwe, 1999; Zadra, 2000). Thus correct use of appropriate teaching methods is critical to successful teaching and learning of chemistry. Active learning has shown significant advantages over conventional instruction in regard to not only factual recall but also in knowledge of process skills (Taraban, Bok, Myers, pollard & Bowen, 2007). Educational theorists (Garris, Alhers & Driskell, 2002) have stated that hands-on activities that can enhance achievement are important in the learning process.

Brainstorming (Robinson, 1995) is a teaching strategy in which the teacher conceives self as flexible, permissive, interested in stimulating discussion and seeing others grow. It is a comprehensive strategy which lays emphasis on what students should learn and how they learn. Lessons in brainstorming strategy are arranged such that each student, ranging from the fastest to the slowest learner, has a contribution to make in a way that each group member serves as a tutor to one another thereby promoting greater flexibility, permissiveness and acquisition of skills in the mastery of the material in question (Sapon – Shevin & Schniedewind 1990).

Furthermore, the shared responsibilities and interactions are likely to generate better inter-group relations, which result in better self – images for students with histories of poor achievement. Thus, the individual learner brings out his/her idea which is subjected to criticism by group members (Gok & Stay, 2009).

Hence it is the free association of different ideas to form new whole – ideas. This confirms Garry (1992)' view that in brainstorming, creative tools can be used by individuals within the group to generate new ideas.

There are different brainstorming techniques, however, all of them have common elements which include;

i. Members of a group must understand that they are parts of a group and that each group has a common goal.
ii. Group members must be flexible to each other's opinion so as to help one another grow in knowledge of the assigned learning task.
iii. Individualized study is not important in brainstorming because it inhibits more outputs, sharing, and criticism.
iv. Teacher should act as a stimulator in the discussion process and watch students keenly to ensure their active participation (Gok and Stay, 2000).

Statement of the Problem

Over the last two decades several contemporary instructional strategies employed in the teaching of chemistry do not seem to have improved students' achievement in the subject to an appreciable extent. This is evident in the poor external examinations (WAEC & NECO) reports that are produced in recent years as recorded by studies. The poor achievement in science (chemistry inclusive) has been attributed to teachers' predominant use of the conventional method which is didactic and teacher-centred. It is therefore, pertinent at this critical time when high premium is placed on science and technology as the bedrock of national development to search for an effective teaching strategy for teaching chemistry in order to enhance maximum outcome. It is against this background that the research problem has arisen in a question form as what effects will

brainstorming strategy have on senior secondary students achievement in chemistry?

Purpose of the Study

The study was determined to investigate the extent to which the use of brainstorming strategy will enhance academic achievement of senior secondary chemistry students. Specifically, the study seeks to:-

1. determine effects of brainstorming on senior secondary school chemistry students' achievement.
2. to compare academic achievement of male and female chemistry students taught using brainstorming strategy.
3. to ascertain whether there is difference in the mean achievement scores of urban and rural students taught using brainstorming strategy and those taught using the lecture method.
4. to compare academic achievement of urban and rural male chemistry students taught using brainstorming strategy.
5. to compare academic achievement of urban and rural female chemistry students taught using brainstorming strategy.

Research Questions

The following research questions have been generated to guide the study:

1. In what way could the mean achievement scores of students taught using brainstorming strategy differ from those taught using lecture method?
2. To what extent do male and female senior secondary chemistry students taught using brainstorming strategy differ in their mean achievement?
3. In what way could mean achievement scores of urban and rural senior secondary chemistry students taught using brainstorming strategy differ from their rural counterparts using the lecture?
4. To what extent do urban male senior secondary chemistry students taught using brainstorming strategy differ in mean achievement from their rural male counterparts?
5. What is the difference in mean achievement scores of urban female senior secondary chemistry students taught using brainstorming strategy and their rural female counterparts.

Research Hypotheses

The following hypotheses have been formulated for testing.

1. There is no significant difference in the mean achievement scores of students who were taught using brainstorming strategy and those taught using lecture method.
2. There is no significant difference in the mean achievement scores of male and female senior secondary chemistry students who are taught using brainstorming strategy.
3. There is no significant difference in the mean achievement scores of urban and rural students taught using brainstorming strategy.
4. There is no significant difference in the mean achievement scores of urban and rural male students taught using brainstorming strategy.
5. Urban female students taught using brainstorming strategy do not differ significantly from their rural counterparts taught using the same strategy.

Method

The research design adopted for the study was the non-randomized control-group pre-test, post-test, quasi experimental design. It was conducted in zone "B" educational area of Benue State. The population of the study consisted of two thousand five hundred and forty senior secondary school chemistry teachers and

students in zone "B" educational area of Benue State. A sample of one hundred and fifty six senior secondary 2 chemistry students was drawn from four senior secondary schools within the study area.

A stratified sampling technique was used in selecting the schools while simple random technique (Hat & Draw) was used to assign selected school into experimental and control groups respectively. Intact classes were used in all the school. The respective class teachers were trained and used as research assistants to teach both experimental and control groups. The respective lesson plan and lesson notes prepared by the researcher were given to the class teachers. In all the selected schools, only one arm was a science class thus, two schools each served as experimental and control groups.

The subjects in the two groups (experimental and control) were administered the pre-test before commencement of the treatment to see if they were academically equivalent. The experimental group was taught using the brainstorming strategy package while the control group was taught same lessons by the conventional lecture method. After four weeks of treatment, both groups were administered the same chemistry Achievement test as post-test to determine effects of treatment.

Result

The results of the study are presented in Tables 2 - 10 in respect of the research questions and hypotheses. The descriptive statistics of means, standard deviation and independent samples t-test were used to answer the research question and test the hypotheses.

Table 1: Mean and Standard Deviation on Achievement in Chemistry

Group	N	Test	Mean	SD
Experimental (Brainstorming)	80	pre	38.15	10.76
		Post	68.23	11.08
Control (Lecture)	76	pre	36.87	10.74
		Post	45.97	12.40

Data in Table 1 show a no significant difference in the mean achievement and standard deviation scores of students in chemistry before the onset of treatment, however there is a higher achievement after treatment by the experimental group over the lecture group with a mean difference of 22.26. This is an indication that the experimental group achieved higher than those of the control group. To ascertain whether this mean difference was significant, the null hypothesis one was tested.

Table 2: t-Test Statistic of the Post Test Mean Scores on Achievement in Chemistry

Group	N	Mean	df	t-cal	t-cri	p-value
Brainstorming Strategy	80	68. 23				
			154	14.61	1.67	0.05
Lecture method	76	45.97				

Data in Table 2 show that t-cal of 14.61 is higher than t-cri of 1.67. Owing to the higher value of t-cal over t-cri, the null hypothesis one is rejected

Table 3: Mean and Standard Deviation on Achievement of Males and Females in Chemistry

Group	N	Post-test Mean	SD
Males	122	78.21	11.34
Females	34	61.56	12.06

Data in Table 3 show that there is a higher achievement between males (78.21) and females (61.56). The mean difference is 16.64.

Table 4: t-Test Statistic on Achievement of Males and Females in Chemistry

Group	N	Mean	df	t-cal	t-cri	p-value
Males	122	78.21	154	14.68	1.67	0.05
Females	34	61.56				

Data in Table 4 show that t-cal is 14.68 while t-cri is 1.67. With the higher t-cal value over the t-cri value the null hypothesis three is rejected.

Table 5: Mean and Standard Deviation on Achievement of Experimental Urban and Rural Subjects in Chemistry

Group	N	Test	Mean	SD
Urban	90	pre	33.43	10.78
		Post	74.25	11.08
Rural	66	pre	31.58	10.54
		Post	58.34	12.43

Data in Table 5 show that before commencement of treatment, both urban and rural experimental subjects were equivalent in their mean achievement. After treatment, there existed a higher achievement between them with a mean difference of 15.91. Thus, urban experimental subjects achieved higher than their rural counterparts.

Table 6: T-Test Statistic on Mean Achievement of Experimental Urban and Rural Subjects in Chemistry

Group	N	Mean	df	t-cal	t-cri	p-value
Urban	90	74.25	154	14.57	1.67	0.05
Rural	66	58.34				

Data in Table 6 show t-cal (14.57) is higher than t-cri (1.67). Based on the higher t-cal value over t-cri, the null hypothesis two is thus rejected.

Table 7: Mean and Standard Deviation on Achievement of Urban and Rural Males in Chemistry

Group	N	Mean	SD
Urban males	34	66.40	12.12
Rural males	26	45.10	14.34

Data in Table 7 show a higher mean achievement between experimental urban males (66.10) and control rural males (45.10). The differences in the mean achievement scours is 21.30 implying that experimental urban males achieved higher than control rural males.

Table 8: t-Test Statistic of Achievement of Experimental Urban Males and Rural Males in Chemistry

Group	N	Mean	df	t-cal	t-cri	p-value
Urban males	34	66.10	58	3.12	1.67	0.05
Rural males	26	45.10				

Data in Table 8 shows a higher t –cal value of 3.12 over t-cri value of 1.67. Because t-cal is higher than t-cri, the null hypothesis three is rejected.

Table 9: Mean and Standard Deviation on Achievement of Experimental Urban Females and Rural Females in Chemistry

Group	N	Mean	SD
Urban females	12	62	13.20
Rural females	8	61.16	14.35

Data in Table 9 show that there is no significant difference in the mean achievement of urban females (62) and rural females (61.16) taught using brainstorming strategy.

Table 10: t-Test Statistic on Achievement of Experimental Urban Females and Rural Females in Chemistry

Group	N	Mean	df	t-cal	t-cri	p-value
Urban females	12	62	18	0.15	1.71	0.05
Rural females	8	61.16				

From Table 10, t-cal (0.15) is less than t-cri (1.71). Based on the lower t-cal value against the higher t-cri value, the null hypothesis four is not rejected.

Discussion of Findings

The study investigated the effect of brainstorming strategy on senior secondary chemistry students' achievement. The results in Tables 1 and 2 revealed that students taught using brainstorming strategy achieved higher than those taught using conventional method. Data in Tables 3-8 show that urban students taught using brainstorming strategy had higher achievement than their counterpart rural students. These findings have shown that on general basis, the use of brainstorming strategy has positive effects on the students' achievement. These are in compliance of the Chinese educational paradigm: I hear, I forget; I do, I understand. (Ogwo & Oranu, 2006). Furthermore, it agreed with Ibeh and Nwosu (2003); Johnson and Johnson (1999) who discovered that brainstorming strategy promotes higher academic achievement in learners. The higher achievement of males over females supports Afuwape and Oludipe (2008) who had observed that male students achieve significantly higher than female students especially in science subjects. The difference according to the authors have been attributed to unequal exposure of males and females to experiences in the sciences. Other factors for the difference are said to be traditional cultural attitudes of parents towards the female child which restricts her from activities considered masculine.

However, data in Tables 9 and 10 show that there is no significant difference in the mean achievement scores of urban females and rural females taught using brainstorming strategy. This implies that location/site of schools does not effect females' achievement in science rather, it agreed with Afuwape and Oludipe (2008) that the traditional/cultural attitudes of parents towards the female child as regards science is responsible for the difference.

Conclusion and Recommendations

Going by the finding of the study, it is thus conceded that the manner of presentation of a concept goes a long way to affecting the extent of comprehension. The extent of which comprehension takes place is reflected in the performance of the learner in tests/examinations. Thus, it is stated that learner will achieve higher when brainstorming strategy is put into practice using the real approach to it. The use of

brainstorming strategy in teaching chemistry should therefore be encouraged since learners come in contact freely with one another sharing ideas thereby, promoting unity among themselves. Base on the conclusion, the following recommendations are hereby made:

1. Teachers should welcome the use of brainstorming strategy as one of the strategies that can be effectively used in the class room since it has been found to be an effective strategy for improving students' achievement in chemistry.
2. Government and curriculum planners should make provision for the enhanced brainstorming strategies in schools.
3. Teachers should learn how to use brainstorming strategy effectively as is intended by Osborn.
4. Students should be encouraged by teachers to use brainstorming strategy since it lands itself for flexibility, permissiveness, arousing discussion and seeing fellow students grow in knowledge and skills acquisition in the assigned learning tasks.
5. School authority should endeavor to reward teachers who make use of activity – oriented strategies such as brainstorming to enhancing academic achievement of the students.

References

Achor, E.E. (2003). Influence of school location and type on the physics achievement of senior secondary school students. *Journal of the National Association for Science, Humanities and Education Research,* 1 (10), 11 – 16

Awotua-Effebo, E.B. (1999). *Effective teaching principles and practice.* Port-Harcourt, Nigeria: Paragraphics.

Garry, R. (1992). Ability grouping: A sorting instrument. *Illinois schools Journal.* Pg. 43-47

Gok, T. & Stay, I (2009). The effects of problem-solving strategies teaching on problem-solving attitude in the cooperative learning groups in physics education. *Journal of Theory and Practice in Education,* 4, 253-266 (2008).

Grauwe, A. (1999). The challenges for the school of the future. IIEP Newsletter, vol. xvii, No. 4

Johnson, D.W. & Johnson, R.T. (1999). *Learning together and alone: cooperative, competitive and individualistic learning.* Boston: Allyn & Bacon.

Kuiper, R. (2002). Enhancing metacognition through the reflective use of self-regulated learning strategies. *The Journal of Continuing Education*

Ogbeba, J.A. (2009). *Effect of prior knowledge of Instructional objective on senior secondary school students' motivation and achievement in Biology.* Unpublished PhD Thesis, Faculty of Education, Benue State University, Makurdi

Ogwo, B.A & Oranu, R.N (2006). *Methodology in formal and non-formal technical/vocational education.* Enugu: Ije jas printers & publishing company

Ohodo, G.C. (2005). *Principles and practice of chemistry Education in Nigeria.* Enugu: General studies Division, Enugu state University of sciences and Technology.

Oyedokun, C.A. (1998). The *effect of a conceptual change model on students' achievement, retention and attitude in*

biology concepts. An unpublished Ph.D thesis, ABU, Zaria.

Ozmen, H. (2008). The influence of computer-assisted instruction on students' conceptual understanding of chemical bonding and attitude toward chemistry: A case for Turkey. *Computers & Education*, 51 (1), 423-438.

Taraban, R.; Bok, C.; Myers, R.; Pollard, R.; & Bowen, C.W. (2007). Effects of Active-learning Experiences on Achievement, Attitudes and Behaviors in High schools Biology. *Journal of Research in Science Teaching*, 44(7), 960-979

Timberlake, K. (2002). Using students centred learning strategies in chemistry classroom. Retrieved on April 24, 2007 from http://www.karentimberlake.Com /studentcentreclassroom.htm

Umoren, G. U. £ Aniashi, S.O. (2007). Prior presentation of behavioral objectives and students' achievement in Biology. *Education Research and Review*, 2 (2), 22-25

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