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ACTIVITY-BASED TEACHING STRATEGY AND STUDENTS' ACHIEVEMENT ON THE CONCEPT OF CHEMICAL KINETICS IN SENIOR SECONDARY SCHOOLS CHEMISTRY

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Abstract

The paper investigated activity-based teaching strategy and students' achievement on the concept of chemical kinetics in senior secondary schools. The population comprised all senior secondary two (SS2) chemistry students in all the 13 public secondary schools in Itu Local Government Area. One hundred (100) senior secondary two (SS2) chemistry students randomly selected from the two selected schools formed the sample for the study. One school was assigned the Experimental Group and one school was assigned the control group. Chemistry Achievement Test (CAT) on chemical kinetics was the instrument used for gathering data for the study. Instrument validation was carried out by two lecturers of Test and Measurement in the Department of Science Education, University of Uyo. Test-retest method was used to determine the reliability of the instrument which was correlated using Pearson product Moment Correlation (PPMC) and this yielded a coefficient of 0.82. Data obtained from experimental and control groups were analysed using mean (X), standard deviations (SD) and t-test analysis. The findings revealed that students taught with Activity-based teaching strategy achieved higher than students' taught with lecture method. The study also found that there was no significant difference in achievement scores of male and female chemistry students. Based on the findings, it was recommended amongst others that students should be given opportunities to explore new, creative and functional approaches using activity-based teaching strategy to acquire relevant laboratory experiences and develop practical skills in chemistry.

Keywords: Activity-based teaching, Student's achievement, Chemistry, Chemical kinetics

Introduction

Effective teaching strategy employed by a teacher is a major contributory factor that influences a learner's understanding of concept introduced. A teaching strategy therefore, is the way a lesson is approached that will be used to achieve a set of given objectives. Teaching, especially chemistry is indeed a complex process (Geraldine & Delano, 2008). Teaching strategy is a major determinant of students' achievement in chemistry and in the implementation process of instructional delivery. If the proper choice of strategy is made and the plan well executed, students will actively engage in the lesson and derive benefit immensely (Aniodoh & Egbo, 2013).

Good planning skills are needed by teachers to structure appropriate learning techniques to enhance students learning experiences. For example, choice of instructional strategy may be linked to home learning experiences of natural food resources that are useful for teaching chemistry concepts of carbohydrates and carbonates.

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These may be linked to processing mills like sorghum, cocoa-seeds, maize, groundnut and millet, where nature, science and environmental working tools interact to achieve a set of learning objectives.

There are a variety of teaching strategies from which a teacher can select for the teaching and learning of chemistry, but the method to be employed will depend on a number of variables ranging from subject matter, age of students, the teacher and environmental variables. No particular method can be said to be the best for teaching. The teaching-learning of chemical kinetics requires natural environment for reaction dynamics to take place on the effective learning of chemical phenomena. Two or more teaching strategies could be employed within a lesson content delivery for effective learning to take place. Activity-based teaching is herein considered.

Activity-based teaching is an instructional model that focuses on the use of experiences such as observing, comparing, investigating, reporting, selecting, testing, calculating, modeling about what one see, feel, experimenting and imaging. It involves the following:

- Memorizing that has to do with sequencing, ordering, connecting with given knowledge, using different modes of perception and finding regularities.
- Understanding involving structuring, ordering, classifying, constructing, solving, planning, predicting, applying knowledge, formulating new ones, interpreting, evaluating and summarizing.
- Organizing activities based on curricular aims and bringing together the needs, ideas, interests and characteristics of learners with the knowledge, skill, experience and personality of the teacher. All these qualities facilitate students' grasp of experimental concepts in chemistry.

Activity-based teaching strategy is a technique adopted by a teacher to emphasize his/her method of teaching through activities in which students participate rigorously to bring about efficient learning experiences. It is an experiential, brain-based inquiry teaching strategy that describes a broad range of pedagogical approaches integrated to influence teaching and impart critical thinking. Activity teaching is a student centred approach in which the student is actively involved in participating mentally and physically doing hands-on, minds-on experiments and activities. Learning by doing is the main focus and is imperative in successful learning since it is well proven that the more the senses are stimulated, the more a person learns and the longer the learner retains (Limbu, 2012). Activity-based approach is an instructional model that is interactive; problem- solving oriented and builds on knowledge known by the learner. Pintrich, (2001) posited that in an activity based teaching, learners willingly with enthusiasm internalize and implement concepts relevant to their needs and this encourage the learners to use their minds and all the senses. As students are active learners and active investigators of their environment they try to make sense of the world around them. Students learn by experience, memorize and understand new skills as teaching is transmitted through creative means like plays and other concept-connecting activities. It believes that learning should be a combination of fun and seriousness. Students learn best if they are actively engaged in an activity and if these activities are closely linked to understanding important chemical concepts they find it very useful in the development of basic science process skills.

In activity-based teaching the following qualities are to be effectively applied: knowledge of subject matter, good grasp of central concepts, inquiry tools, subject structure being taught that can create learning experiences and make concepts meaningful to students

(Etiubon,2012). Laboratory activities goes on hand in hand with students active participation. The teacher is a resource person and needs to provide student with data and necessary materials to focus their thinking and interaction on the lesson. This is to enable them process and analyze the information provided. In this case, teachers need to be actively involved in directing and guiding the students' analysis of the information supplied. This requires active problem-solving by students and finding patterns in the information through their own investigation and analysis. With continued practice in these processes (Limbu, 2012) students learn not only the content of the lesson but also develop many other skills: These skills include enhancing creative aspect of, experiences giving reality to learning, using all available resources, providing varied experiences to students to facilitate the acquisition of knowledge. If the learner is given an opportunity to explore on his own and then provided an optimal learning environment, the learning then becomes joyful and long-lasting (Shukla, 2011). Teachers need to use interesting, stimulating and exciting strategy like activity-based teaching to bring out creative skills, competence, understanding and knowledge of concepts for students appreciation of concepts in chemistry (Etiubon, 2012). Aderanti (2011) opined that teachers need to be up and doing to be able to think up activities that will arouse students' interest and keep them working until the objectives of the lesson are achieved. Poor teaching techniques employed by chemistry teachers have been observed as one of the factors that hinders effective teaching-learning process (Ada, 2004).

Chemistry is an important practical subject that engage learners in a learning situation thats active and meaningful. Unfortunately, curriculum is dynamic, but teaching is mostly theory, ignoring practicals make it unable for students to explore opportunities in chemistry. Chemistry is an experimental subject that engages learners in activities that provoke meaningful learning. Chemistry is practical-oriented and needs concrete, tangible materials and objects to make its teaching and learning fun and exciting. It builds in the learner an inquisitive spirit, sound initiative ability and creative skills that will subdue the world around us (Uduchukwu, 2011). Inspite of chemistry teaching being fun, it is sorrowful to say that poor environment stimulation and probably the unexciting methods used in teaching chemistry hampers student understanding (Opateye, 2011).

Gender is a relative term to students' achievement in chemistry. Some literature show no significant differences in the performance of students, as both male and female students performances may be equal in most academic years. Udosen (2006) posited that gender is not a significant factor to be associated with school achievement. However, Macoby and Jacklin (1999) in Effiong and Odey (2013) found that there is a consensus opinion not due to natural differences in the intelligence of both sexes but is attributable to environmental influence. From early life, boys are given opportunities to manipulate objects such as repairing electrical gadgets and making toy-cars with pieces of metals that involves mathematical principles of science, technology to mathematics. Girls are often denied these opportunities and experiences as they enter school inexperienced and feeling incapable and inadequate at handling science concepts involving mathematics. Researches show that girls on the average do have greater verbal ability and writing skills than boys. Boys on the average excel in mathematics ability and manipulative skills.

Chemical kinetics is a chemistry concept that deals with the rates of chemical processes. It includes investigations of how different experimental conditions can influence the speed of a chemical reaction and yield information about the reactions mechanism and transition states, as well as the construction of mathematical models that can describe characteristics of a chemical reaction. Chemical kinetics deals with the experimental determination of reaction

rates from which rate laws and rate constants are derived (Wikipedia, 2014). Relatively simple rate laws exist for zero-order reactions for which reaction rates are independent of concentration.

Many factors influence chemical kinetics. These factors include; physical state of the reactants which affects the rate of change. Concentration; that affects reactions are due to collisions of reactant species; the temperature that facilitates reaction yields and the catalysts that speeds up the rate of reactions. These phenomena are complex and so most students regard chemistry as difficult and abstract. Hence, employing a strategy that is action-based and creative stimulate curiosity in the children and give them a drive to find out. It is on this basis, that the study sets out specifically, to:

1. Find out the performance of chemistry students taught chemical kinetics using activity-based teaching approach and lecture method
2. Compare the performance of male and female students taught chemical kinetics using activity-based teaching approach and those taught with lecture method.

Statement of the Problem

Teaching strategies pose great challenges to teacher. Chemistry teachers leave teacher training programmes in their institutions without adequate grasp of teaching methodologies. This hampers their teaching effectiveness. Exposing chemistry teachers to a variety of teaching techniques help them develop skills they could apply in other teaching/learning situations. It is on the basis of the inadequacies of a good knowledge of teaching strategies application that this study sets out to investigate Activity-based teaching approach and students' achievement on the concept of chemical kinetics.

Research Questions

1. What is the mean achievement score of students taught chemical kinetics using activity-based teaching approach and those taught using lecture method.
2. What differences exist between the mean achievement scores of male and female students taught chemical kinetics using activity-based teaching approach.

Research Hypotheses

There is no significant difference on the mean achievement scores of students taught chemical kinetics using activity-based teaching strategy and those taught with lecture method.

Research Method

The study adopted a quasi-experimental design and was carried out in Itu Local Government Area of Akwa Ibom State. The population comprised all the Senior Secondary Two (SS2) students in all the 13 public co-educational secondary schools in Itu Local Government Area. Two secondary schools out of the 13 public co educational schools were randomly sampled and used for the study. Using simple random sampling technique one hundred (100) senior secondary two (SS2) chemistry students were selected and this formed the sample for the study. One school was assigned the experimental group and one was assigned the control group. The experimental group was taught the concept of chemical kinetics using Activity-based teaching strategy while the control group was taught the same concept using lecture method. Pretest was administered to the students before the commencement of treatment. Chemistry Achievement Test (CAT) on chemical kinetics was the instrument used for gathering data for the study. CAT consisted of twenty (20) multiple-choice test items. Each

question had 5-options with 5-point score for each correct answer, and zero for each incorrect answer. Hence, 100 was the maximum score and zero (0) was the minimum. Treatment lasted for 2 weeks. Post-test was administered after the treatment. Instrument validation was carried out by two lecturers of test and measurement in the Department of Science Education, University of Uyo. The reliability of the instrument was done using the test-retest method obtained by trial-testing the instrument on thirty (30) students who were not among those selected for the study but had the qualities of those chosen for the study. After 2 weeks, the instrument was again administered to the same set of students. Data obtained were correlated using Pearson Product Moment Correlation (PPMC). The reliability coefficient of 0.82 was obtained. Data collected from both the experimental and control groups were analyzed using mean(X) and standard deviation (SD) to answer the research questions while the hypotheses were tested using t-test analysis at .05 level of significance.

Results of Data Analysis

Research Question 1

Table 1: Mean and standard deviation of students' achievement scores taught with activity-based strategy and lecture method

Method		Pretest		Posttest		Mean Gain
	N	$\bar{X}$	SD	$\bar{X}$	SD	
Activity-based	50	11.34	3.19	26.36	4.58	15.02
Lecture method	50	11.26	3.19	23.56	5.94	12.30

Data in Table 1 showed that students taught chemical kinetics using activity-based teaching strategy had a mean score of 26.36 and those taught with lecture method had a mean score of 23.56 respectively. This showed that students taught the concept of chemical kinetics using activity-based teaching approach achieved higher than those taught with lecture method.

Hypothesis 1

There is no significant difference in mean achievement scores of male and female students taught chemical kinetics using activity-based teaching strategy and those taught with lecture method.

Table 2: Result of t-test analysis of post achievement scores of students taught with activity-based teaching strategy and those taught with lecture method

Method	N	$\bar{X}$	SD	df	tcal	tcrit	Decision at p<0.05
Activity-based	50	26.36	4.58	98	2.64*	1.98	Significant
Lecture	50	23.56	5.94				

*Not Significant at .05 level of significance

The table showed that the tcal value of 2.64 is higher than the tcrit value of 1.98 at degree of freedom (df 98) at .05 alpha level of significance. This indicated a significant difference between the two. This implied that there was a significant difference in the achievement scores of chemistry students taught using activity-based teaching strategy and those taught

using lecture method. Thus, the null hypothesis 1 at $p < 0.05$ level of significance was rejected.

Research Question 2

Table 3: Mean and standard deviation of male and female students' achievement scores taught with activity-based strategy

Gender		Pretest		Posttest		
	N	$\overline{X}$	SD	$\overline{X}$	SD	Mean Gain
Male	52	11.60	2.97	25.69	5.09	14.09
Female	48	10.98	3.38	24.17	5.79	13.19

Data in Table 1 showed that students taught chemical kinetics using activity-based teaching strategy had a mean score of 25.69 and those taught with lecture method had a mean score of 24.17 respectively. This showed that male chemistry students taught the concept of chemical kinetics using activity-based teaching approach achieved higher than their female counterparts taught with activity-based teaching strategy.

Hypothesis 2

Table 4: Result of t-test analysis of post achievement scores of male and female students taught with activity-based teaching strategy and those taught with lecture method

Gender	N	$\overline{X}$	SD	df	tcal	tcrit	Decision p<0.05
Male	52	25.69	5.09	98	1.40	1.98	NS
Female	48	24.17	5.79				

NS = Not significant at .05 level of significance

The table showed that the tcal value of 1.40 and tcrit value of 1.98 at degree of freedom (df 98) at .05 alpha level of significance indicated a no significant difference between the two This implied that there was no significant difference in the achievement of male and female chemistry students taught using activity-based teaching strategy. Thus, the null hypothesis 2 at $p < 0.05$ level of significance was retained.

Discussion of Findings

The findings of the study in Table 1 show that chemistry students taught using activity-based teaching approach had high mean achievement scores compared to those taught using lecture method. The students were curious and had the drive using hands-on and minds-on activities to find out facts for themselves. This may be as a result of change of teacher approach from a conventional approach to a more practically-based teaching approach. This finding agrees with the findings of Shukla (2011) that if the learner is given an opportunity to explore on his own and then provided an optimal learning environment, the learning then becomes joyful and long-lasting. Helping learners enhance creative experiences will facilitate knowledge acquisition of practical concepts in chemistry. Okoro (2007) also posited that if the teacher introduces novelty into teaching, the ability and interest of students will be aroused. Findings in Table 2 indicated that the male chemistry students did not achieve significantly higher than their female counterparts when taught with activity-based teaching strategy. This is in line

with Udosen (2006) who posited that gender is not a significant factor to be associated with school achievement. If given the opportunity with the right learning environment that stimulates interest and curiosity for exploring new ideas, male and female students will achieve equally.

Conclusion

High achievement in chemistry is possible if active and student-centred teaching approaches such as activity-based teaching strategy is applied by teachers to teach chemistry concepts. From the findings, it is observed that the performance of students relies solely to a great extent on the strategy used by the teacher to teach concepts in chemistry, particularly when they are practically-based.

Recommendations

The following recommendations were made following the findings:

1. Chemistry teachers should use student-centred, active teaching approaches such as activity-based teaching strategy to enable students internalize concepts considered difficult and abstract in chemistry.
2. Students should be given opportunities to explore new, creative and functional approaches like activity-based strategies to acquire relevant laboratory experiences and practical skills in chemistry.
3. Conferences, seminars, workshops and teachers' competency tests should be made mandatory for every chemistry teacher to make them acquainted with, and gain knowledge on emerging, easy-to-use teaching approaches such as activity-based strategies.
4. School administrators, educational stakeholders and all tiers of government should make funds available always for equipping laboratories to carry out effective demonstration of activity-based teaching strategy to enable learners acquire appropriate skills to facilitate the knowledge of chemistry.

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