Exploring the Efficacy of Context-Based Instructional Strategy in Fostering Students' Achievement in Chemistry in Agbani Education Zone, Enugu State Nigeria

Charles U Eze, Enugu State University of Science and Technology, Nigeria
Joy Johnbest Egbo, Enugu State University of Science and Technology, Nigeria
Bernadine N. Nweze, Enugu State University of Science and Technology, Nigeria
Cynthia O. Omeje, Enugu State University of Science and Technology, Nigeria

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Abstract
The study investigated the effect of Context-Based Instructional Strategy (CBIS) on students' achievement in chemistry. CBIS was used as experimental group and Expository Instructional Strategy (EIS) as control group, sources showed that students' poor achievement in chemistry is from teaching strategy adopted by the chemistry teachers. Two research questions were answered and two null hypotheses were formulated and tested. This strategy recognizes the need for student-centered, relevance of tasks and students' voice; it also helps students develop creative and critical learning skills. A quasi-experimental (Non-equivalent, pretest, posttest control group) design was adopted for the study. The population for the study comprised all senior secondary class one (SSI) students who were offering chemistry in co-education schools in Agbani Education zone. The instrument for data collection was a self-developed Basic Chemistry Achievement Test (BCAT). Relevant data were collected from a sample of SSI chemistry students using purposive random sampling techniques from two co-education schools in Agbani Education Zone of Enugu State, Nigeria. A reliability co-efficient of 0.85 was obtained for the instrument using Kuder-Richardson formula20. Mean and standard deviation scores were used to answer the research questions while two way analysis of covariance (ANCOVA) was used to test the hypotheses. The findings showed that the experimental group taught with Context-Based Instructional Strategy (CBIS) obtained a higher mean achievement score than the control group in the post BCAT; male students had higher mean achievement scores than their female counterparts. The difference was significant. It was recommended, among others, that CBIS should be given more emphasis.

Keywords: Context-Based Instructional Strategy, Expository Strategy, Student-Centered

Introduction

Science is taught in Nigerian junior secondary schools as Basic science. However, at the senior secondary levels, science is taught in compartmentalized disciplines as chemistry, physics and Biology. All these branches of science have their individual contributions to the technological advancement of any nation. One of such disciplines is chemistry. Chemistry is a branch of science that deals with the composition, properties and reaction of matter in its different forms. Aniodoh (2002). It is an important aspect of science, since it provides mankind with knowledge, skills, principles and facts that find application in virtually all aspects of human endeavors. Mastery of it facilitates candidates' chance of enrollment in many professional courses. Such professions are teaching, agriculture, engineering, medicine, pharmacy, nursing, among others. In teaching, chemistry teachers transmit knowledge of chemical concepts and principles from one generation to another. Among the candidates who sat for the chemistry examination only 21.39% scored credit 22.25% had pass while 52.8% failed. So a total of 74.53% could not use their result for further studies.

Students' poor achievement in Chemistry has been blamed on poor quality of teaching method (Aniodoh & Egbo 2014). According to Nworgu (1997), traditionalism is a tendency to carry on with old ideas, and old ways of doing things, operating with old systems and frames, and ignoring for too long, waves of change blowing across and over the globe. To reverse rigidity in traditional education, such strategy as Context-based Instructional strategy is used. It recognizes the need for student-centeredness, relevance of tasks and students voice (Walters, 2004). Schwartz (2006) provides us with a metaphor which shows a clear picture of curricular problem to address when developing Context-Based Instructional strategy (CBIS). "Most of us who are scientists have enjoyed climbing this ladder as part of our education. We revel in the lofty view from the top. Unfortunately, many students do not see the connection between the successive rungs. They are not told and do not discover· why and where they are climbing. Before long, they develop vertigo. Often they jump or fall off the ladder before they reach the top. All they take from the experience is distaste from science" (Schwartz, 2006:981).

According to (Schwartz, 2006) while using the traditional framework, the students do not see the real-life connection of what they study, why they should study it or the usefulness of what they study. So they end up with frustration, poor achievement. Students' achievement in senior secondary school certificate examination (SSCE) has not been encouraging. This is equally evidenced from WAEC chief examiner's Report 2015 - 2020; Eze, Egbo and Omeje 2020, Egbo 2014, Ani and Egbo 2015. The West African Examination Council (WAEC) chief examiner's Report (2002: 143) corroborated the fact that student's achievement in chemistry has been consistently poor. According to WAEC chief examiners report, Candidates had difficulties tackling questions dealing with reasoning, deductions/ application of principles and calculations. Their responses indicated shallow knowledge of some topics, like electrochemistry/ IUPAC nomenclature for both organic and inorganic compounds. Expressions, definition and explanations were poor. Other areas of difficulty included: poor numbering/mixing up of number of answers to questions, writing of questions, inability to draw and label energy profile diagrams properly, linking practical experience with theoretical knowledge, use of wrong chemical terms. (WAEC 2015: 143). Eze, Egbo and Omeje (2018) emphasized that: "when science teaching is dull, confusing, trivial and makes limited and sometimes meaningless demands on students' intelligence, capabilities and talents, then learning is bound to be stunted, if it occurs at all. "This calls for a teaching strategy that is more meaningful and leaner-centered.

Context-Based Instructional strategy is a teaching strategy which uses questioning skills and "broad socio-scientific events based on real-life experiences, to expose the students to the context of science phenomena under study. The instruction is enriched with relevant teaching materials or use of informal science experiences (zoos, factories, nature centers). Information is not provided by experts the authority but come from multiple sources. Focus is on finding out the unknown rather than testing established theories. The students on their own part work collaboratively as a team. The strategy is learner-centered, flexible and democratic. It is rooted in Dewey's pragmatic philosophy of progressive education (Williams 2006). The method sustains the learners' interest. The theories learnt in the class go simultaneously with hands-on-activities." Context-based can give meaning and coherence to new knowledge. The learner is enabled to contextualize. There is possible usefulness of the knowledge outside school. It is supposed that students who use context develop wider web of chemical concepts. So, the chemical concepts are weaved together vertically and horizontally to establish interdependent relationship between that is learnt in the kinetic theory and gas laws with their real life applications. The teacher guides the instruction but most times uses students as experts in facilitating the class instruction. Chemistry students' achievement may be enhanced by the use of Context-Based Instructional strategy. So, the treatment may serve as an intervention package.

Gender as a factor in science achievement, has generated the research interest of some science educators worldwide. Williams (2006), in his study to determine the efficacy of Contextual Learning Instructional Package (CLIP) on Learner's Academic Achievement in Biology revealed that no difference existed in the performance of male contextual learners and their female counterparts in an achievement test. He discovered that contextual learning was gender insensitive as there was no significant difference between the mean achievement score of male and female learners in Biology. Ani & Egbo (2015) corroborated this indifference in gender achievement in chemistry. Egbo (2014) observed that male chemistry students achieved slightly better than their female counterparts. Considering all these views, one cannot draw conclusion on the effect of gender on achievement in science. Therefore, there is need to consider gender as a factor in this study. All these forgoing discussions make this study inevitable. Therefore, it becomes necessary to address the effect of Context-Based Instructional Strategy· (CBIS) of teaching chemistry on students' achievement in Agbani Education zone.

Use of Context-Based Instructional Strategy in Teaching Chemistry

The word "context" originates from the Latin language in the verb form "contexere" meaning "to weave together". The noun form "Contextus" means "Coherence", "connection and or, "relationship" (Gilbert 2006). According to Hornby (2006) "context" is the situation in which something happens and that helps you to understand it. Context is created through the use of driving questions based on real world experience and the use of anchoring events, which expose students to the phenomenon under study (Walters 2004). The relevant materials for teaching the subject matter are brought into the class. Context can be created by the use of diagram, model chart, film or map; the context created is the focal event that is put in the spotlight. Context provides a mental surrounding" to which subsequent ideas can be related (Gilbert 2006). Implied, CBIS is a method which uses questioning skill and a broad based socio scientific focal event based on real world experience to expose students to the context of science phenomenon under study. The teacher needs to bring together the students' views of a context and its socially acceptable attributes. As the teacher weaves together the views, interconnected concepts from natural and social science is obvious and web like. Context

facilitates transfer of knowledge from one discipline to another. Concepts are related to their applications. Applications affect the meaning attributed to the concepts. A concept in a science may be changed when it is applied in technology. For instance, in chemistry "pure water" is a single substance not containing other substances and having specific thermodynamic properties. On the other hand, in 'environmental chemistry "pure chemistry" is water that is safe to drink and contains no toxin. Context is formed by the juxta-positioning of concept and application in a students' cognitive structure (Gilbert 2006). The greater the degree of reproducibility in the relationship of concepts and application the more science. Context-Based instructional strategy is based on Dewey's progressivism which advocated for the relationship between a child's experience and interest with application to real-life (Williams 2006). Context-based learning instruction demands that the learner appreciates the real world applications of what is studied in school science learning contexts. Students are more motivated to find out what they find relevant to their lives. For the learner, "context" is a situation defined through interactions in and with the world that are themselves historically situated and culturally idiosyncratic (Walters, 2004). Students actively learn in group .In places that offer learning opportunities such as classroom, laboratory, field, factory or web site. At any time in the learning process, the learner sees the point of what he is doing. Theory and practical activities are combined in a lesson. This is an intervening method in the present study: According to Walters (2004), "The instructional design involves the following four phases:

Meeting phase: Pupils are familiarized with the context.

Curiosity and planning phase: students are encouraged to question; everyday life-referred and specialized chemical aspects are considered; the pupils' questions are collected.

Development phase: Pupils solve aspects of problem and their questions as independently as possible.

Recess and cross linking phase (making connections): Vertical linkages with contents from the preceding instruction; horizontal linkages with concepts generated within the contexts. The information come from multiple sources and are weaved together to form a web of interrelated concepts. So many concepts are connected to the context. This is an intervening method in the present study.

Expository Method

The Expository Method is the most commonly used method of teaching science it is referred to as "positivist", "idealist", "traditional", approach. In method, the relationship between the teacher and the learner is linear (Walters 2004). The teacher is seen as an expert and a reservoir of knowledge while the learner is a novice in the learning process. Learning is seen as the process of adding new concepts to the repertoire of concepts held by the learner in order to arrive at an ever increasing perfect conception of the phenomenon (Mbajiorgu 2003). According to Fusco (2001), it does not give enough room for students to discover new truths, new ideas and techniques of solving life problem. The student’s task is to assimilate with minimal interference to the teaching process, the ideas information being passed on by the teacher. He can ask questions, only to clarify uncertain aspects of the ideas (Mbajiorgu 2003). Students have the tendency to memorize facts and principles, most of which they do not understand but only to regurgitate them during examination. The teacher combines "chalking" and "talking" simultaneously. The teacher does most of the talking. Real life

experiences are not capitalized upon in the learning process. It does not also give opportunity for conceptual understanding and development of process skills.

Purpose of the Study

The study sought to explore the efficacy of Context-Based Instructional strategy on student's achievement in chemistry. Specifically, the study intended to:

1. The effect of Context-Based Instructional strategy CBIS (experimental) on students' achievement in Senior Secondary One (SS1) when taught Kinetic theory and gas laws as measured on Basic chemistry Achievement Test (BCAT);
2. The influences of gender on SSl students' mean achievement scores in Chemistry when taught Kinetic theory and gas laws, using CBIS and Expository method (EM), measured on a Basic Chemistry Achievement Test (BCAT).

Research Questions

The following research questions guided the study:

1. What are the mean achievement scores of SS1 Chemistry students when taught kinetic theory and gas laws using Context-Based Instructional strategy and Expository Method measured by Basic Chemistry Achievement Test (BCAT)?
2. What are the mean achievement of male and female student taught kinetic theory and gas laws using Context-based Instructional strategy and expository Method, as measured by Basic Chemistry Achievement Test (BCAT)?

Hypotheses

The following hypotheses which were tested at 0.05 level of significance were formulated to guide the study:

HO_1: There is no significant difference in the mean achievement scores of SS1 chemistry students when taught kinetic theory and gas laws using Context-Based Instructional strategy and Expository Method as measured by Basic Chemistry Achievement Test.

HO_2: No significance difference exists in the mean achievement scores of male and female SS1 chemistry students when taught kinetic theory and gas laws using Context-Based Instructional strategy and Expository Method as measured by Basic Chemistry Achievement Test.

Methodology

The design for this study is quasi-experimental research design, specifically pretest, posttest, non-equivalent control group design. The design was used because of non-randomization of the subject. The research subjects were not randomized because of problems of re-arrangement or re-grouping of intact classes. The population for the study consisted of all senior secondary class one (SSI) chemistry students in public co-education schools in Agbani Education Zone of Enugu State Nigeria numbering one thousand seven hundred and fifty two students (1752).

The choice of co-education secondary schools was that gender was a factor in the study. Sample of three hundred and twenty (320) chemistry students were used. Random sampling technique was purposive used to select two co-education schools. In each of the sampled schools all the SS1 chemistry students were used as research subjects. One intact class was

assigned to Context-Based Instructional Strategy (CBIS) group while the other intact class was assigned to Expository strategy (EM) group. Basic Chemistry Achievement Test (BCAT) was used as instrument for the study. The instrument consisted of forty (40) multiple choice objective questions developed by the researchers. The choice of SSI students was due to the fact that kinetic theory and gas laws are under SSI chemistry scheme of work as contained in the chemistry curriculum of Federal Ministry of Education.

Procedures

Two instructional methods were used for the study. The context-based instructional strategy (CBIS) and expository method (EM). CBIS was for the experimental group while the EM was for the control group. The regular chemistry teachers were used for the treatment both the pretest and posttest were administered to the experimental and control subjects in the first and fourth week respectively. One hour was allowed for both the pretest and posttest. The question papers and the answers collected from each student in both the experimental and control group. The reason for retrieving question papers was that the same question will be used for the post test. After the treatment, the pretest were reshuffled and printed on a coloured paper to give it a different look, before it was used for the posttest. The subject teachers did the supervision and invigilation. The scores for the two groups were kept separately and used to answer the research questions and test the hypotheses. The treatment was administered for a period of four weeks. The test retest technique was used to determine the reliability co-efficient of the instrument and the reliability co-efficient of 0.85were obtained. Data collected were analyzed using mean and standard deviation specifically mean and standard deviation were used to answer the research questions while analysis of covariance ANCOVA was used to test the hypothesis at 0.05 level of significance.

Result

Research Question One: what are the mean achievement scores of SSI chemistry students when taught kinetic theory and gas laws using Context Based Instructional strategy and expository method measured by Basic Chemistry Achievement Test (BCAT)?

Table 1: The mean and standard deviation scores of SSI chemistry students when taught kinetic theory and gas laws, using Context-Based Instructional strategy and expository method as measured by BCAT.

Method	Statistics	Pretest	Posttest
Experiment	Mean	12.05	20.49
	N	160	160
	SD	7.39	6.65
Control	Mean	10.83	14.75
	N	160	160
	SD	5.76	6.18
Total	Mean	11.44	17.62
	N	320	320
	SD	6.65	7.02

Table one showed the mean scores and standard deviation of SS1 chemistry students taught kinetic theory and gas laws experimental and control groups measured by BCAT. It indicates that the experimental group obtained mean achievement scores of 12.05 and 20.49 respectively in the deviations of 7.39 and 6.65 respectively in the pre-BCAT and the post-

BCAT. On the other hand, control group had mean scores of 10.83 and 14.75 respectively in the pre BCAT and the post-BCAT. The standard deviations for the control group in the pre BCAT. The standard deviations for the control group in the pre BCAT on the post BCAT were 5.76 and 6.18 respectively. The results presented in the table one indicated that the experimental group obtained a higher mean score (20.49) than the control group in the post-BCAT (14.75).

Research Question Two: What are the mean achievement scores of male and female students taught kinetic theory and gas laws using Context Based Instructional strategy and expository method, as measured by Basic Chemistry Achievement Test (BCAT)?

Table 2: The mean and standard deviation score of male and female students when taught kinetic theory and gas laws using context based instructional strategy and expository method measured by (BCAT).

Pretest Posttest Gender

Gender	Statistics	Pretest	Post test
Male	Mean	12.48	18.07
	N	155	155
	SD	6.47	6.83
Female	Mean	10.46	17.19
	N	165	165
	SD	6.68	7.19
Total	Mean	11.44	17.62
	N	320	320
	SD	6.65	7.02

Table 2: Indicated that male students obtained the mean scores of 12.48 and 18.07 in the pre-BCAT and post- BCAT respectively. The male students got standard deviations of 6.47 and 6.83 in the pre- BCAT and post- BCAT respectively. The female students had mean scores of 10.46 and 17.19 in the pre BCAT and post- BCAT respectively. The female students obtained SD of 6.68 and 7.19 in the pre- BCAT and post BCAT respectively. The result presented in the table two indicated the male students had higher mean achievement scores than their female counterparts.(17.19).

Hypotheses

HO_1: There is no significant difference in the mean achievement scores and SS1 chemistry students when taught kinetic theory gas laws using context-based instructional strategy and expository method, as measured by BCAT.

HO_2: No significant difference exits in the mean achievement scores of SS1 male and female chemistry students when taught Kinetic theory and gas laws using Context-Based Instructional strategy and Expository Method, measured by BCAT.

Table 3: Analysis of covariance of students mean achievement scores in BCAT (Instructional Method x Gender).

Dependent Variable: Post-test.

Source	Sum of sq	df	Mean square	F	Sig	Decision
Corr. Model	2997.17	4	749.29	18.53	0.00	NS
Intercept	20651.27	1	20651.27	510.68	0.00	NS
Pretest	204.79	1	204.79	5.06	0.03	NS
Gender	16.31	1	16.31	0.40	0.53	S
Method	2424.67	1	2424.67	59.96	0.00	NS
Gender*Method	135.45	1	135.45	3.35	0.07	S
Error	12738.32	315	40.44			
Total	115070.00	320				
Corr. Total	15735.49	319				

R Squared = .190 (Adjusted R Squared = 180); N5 not significant; S significant

Table 3 showed that the calculated F-value for the effect of Context-Based Instructional strategy on students' achievement (BCAT) was 59.96, significant at 0.05level of significance. This was less than 0.05 level set for the study.

The null hypothesis was therefore accepted. It meant that no significant difference existed in the mean achievement scores of chemistry students taught with Context-Based Instructional strategy and those taught with expositor method.

HO_1: There is no significant difference in the mean achievement scores and SS1 chemistry students when taught kinetic theory and gas laws using context-based instructional strategy and expository method, as measured by BCAT.

HO_2: No significance difference exists in the mean achievement scores of male and female SS1 chemistry students when taught Kinetic theory and gas laws using Context-Based Instructional strategy and Expository Method, measured by Basic Chemistry Achievement Test.

Table 3 showed also that the calculated F-value for the effect of gender on students' achievement in the kinetic theory and gas laws was 0.40 significant 0.53.1evel of significance. It was greater than 0.05 level set for the study null hypothesis was rejected. This meant that there was a significant difference in the mean achievement scores of male and female students in post-Basic Chemistry Achievement Test.

Table 3: analysis of covariance and students mean achievement scores in BCAT (instructional method and gender) dependent variable: posttest.

Discussion

Result on table 1 showed that experimental group obtained a higher mean score than the control group in the post-BCAT. The findings showed that students taught with CBIS achieved better in Basic Chemistry Achievement Test than those exposed to Expository Method. This was in agreement with the findings in William 2006 found in their separate studies that treatment was more effective than the expository method in enhancing students' achievement.

The findings in table two revealed that male students had high mean achievement scores than their female counterparts. The finding is in line with the result of an earlier study by Mbajiorgu (2003) that male students achieved better in sciences than those taught with expository method, male students equally achieved higher than their female counterparts using CBIS.

Conclusion

Chemistry students taught using context based instructional strategy achieved better than those taught with expository method, male students equally achieved higher than their female counterparts.

Recommendations

The following recommendations were made.

(1) The use of CBIS should be given greater emphasis in the curriculum for the pre-service teachers of chemistry and other science subjects.
(2) Curriculum planners should incorporate and emphasize the use of CBIS in the senior secondary school chemistry and other science subjects in general.
(3) Authors of chemistry books should develop books with reflect context-based instructional method with the teacher's guide.

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Contact email: johnbest.egbo@esut.edu.ng