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IMPACT OF GENERATIVE LEARNING MODEL ON ACADEMIC SELF CONCEPT OF SECONDARY SCHOOL STUDENTS IN CHEMISTRY IN ONITSHA EDUCATION ZONE

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Abstract
The study investigated the impact of generative learning model on academic self concept of secondary school students in chemistry in Onitsha education zone. The study adopted a quasi – experimental, design specifically; A sample ofNinety eight (98) SS1 students were used for the study.50 students were used in experimental group and 48 students in control group which consistedof 67 males and 31 females. The instrument used was called Chemistry Self Concept Scale (CSCS) which was scrutinized by two expects with reliability of 0.81using Cronbach Alpha. Mean and standard deviation were used to answer research questions while ANCOVA was used to test the hypothesis. The study revealed thatstudents taught chemistry using GLM instructional strategy had higher mean self concept score than students taught using conventional method. There is a significant difference between the mean self concept scores of experimental group (GLM) and control group (conventional method) in preference of experimental group with higher mean self concept score. The high self concept shown by the experimental group may have been the impact of the exploration and elaboration phases of the generative learning model. These phases are interesting on its own, in the sense that, this phase encourages individual student to explore ideas and apply what they have learnt. Due to these phases student's effort, confidence and self concept which are a component of student academic self concept

towards studying of chemistry may have been stimulated and sustained. The findings of this study reveal that male and female students taught chemistry with generative learning model instructional strategy have almost equal mean self concept scores, there is no significant difference due to gender on chemistry students' means self concept scores. Base on the finding of the this study, it was recommended that Chemistry teachers should incorporate generative learning model as one of the instructional strategy used in teaching concepts in chemistry and Counselors should organize orientation for Senior Secondary year one (SS1) students on science this will serve as a significant practical approach to explain to the students the importance of academic self concept in science learning.

Introduction

Science is important in modern life. It is the noise of machine, car, mills and factories which awakens us every day in the morning. The food we eat, the clothes we wear, the book and paper we read, all have one thing or the other to do with the application of science. It was in recognition of the importance of science that Nigeria Government has continued to make serious effort towards providing her citizens with qualitative and quantitative science education programmes. In addition, looking at the modernization that takes place every day, the world work force requires people who could have acquired the necessary attitude and skill of science and technology. That is why Nzewi (2011) stated that, science and technological education are regarded as a vehicle for economic and social development in a country and the acceleration and sustainable development depend on the quality of scientists produced from science education. This implies that our nation's advancement in science depends to a large extent on its strong science education programmes.

Science education is the field of study which is concerned with sharing science contents and processes with individuals not traditionally considered part of the scientific community, thereby producing a scientific literate society (Offiah, and Igboegwu, 2010). Science education can be seen as a process of teaching and training especially in school to improve one's knowledge about one's environment and develop one's skill for systematic inquiry. It is important to note that science education and its application in technology are one of the most powerful instruments which can enable all members of the society to

face the dynamic nature of science and modernization of today which chemistry is a part of science.

Chemistry is one of the branches of science that studies the properties, composition, and structures of matter together with the associated changes as well as how such changes impact on the welfare of man and the society (Ojokuku, 2010). Chemistry has made tremendous contributions in the world; it has helped man to understand the complexity of his body, the environment, benefit and hazard of this world. It has been increasingly used in providing solution to problems such as health, agriculture, food, shelter, and manufacturing. There is scarcely a single area of our daily lives that is not affected by chemistry. However, it is disheartening to note that chemistry students' academic achievement through self conceptin the subject in senior secondary school certificate examination has remained consistently poor. This is supported by WAEC Chief Examiner's report (2014) which in summary noted that Chemistry students performed poorly in secondary school certificate examination that year. The poor achievement of students in chemistry has been attributed to some students' factor such as; student sex role stereotyping, lack of interest and negative attitude towards chemistry and teacher related factor such as poor teacher preparedness and application of inefficient teaching methods (Chukwu, 2013). In Nigeria, efforts are being made by researchers, government and non-governmental organizations to diagnose the problems associated with teaching and learning of chemistry in order to proffer solution that lead to better achievement. Could it be that teachers' method of teaching is not effective to improve students' achievement?

Effective teaching involves classroom teaching behavior/interaction between the teacher, the student, the subject matter and combination of these three dimensions (Akuezilo, 2009). To achieve effectiveness, in teaching and learning of science in general and chemistry in particular, teachers need to improve in impacting a self concept attitude towards the students.

Self concept can be referred as a cognitive descriptive component of one's self, and an important construct in psychology and education (Joyce & Shirley, 2007). The earlier proponent of the self concept theory was Cal Rogers, 1947.Cal Roger's as a self enhancement theorist, held that, the self is the central ingredient in human personality and personal adjustment. Joyce and Shirley added that self-concept is a

multidimensional construct, having one general facet and several specific facets, one of which is academic self-concept. Academic self-concept is a person's perception of self with respect tostudent'sself confidence, effort and self perception are components of one's self concept in a particular subject area (Majere, 2013). From the present researchers view, academic self concept is the cognitive, affective and psychomotive description of oneself in academic subject. It involves students' self perception, scholastic competence and skills in chemistry as a subject. According to Shavelson model in Sara, Nielsen and Ellen (2015), academic self concept is characterized by two elements; First, academic self-concept reflects descriptive (e.g., I like chemistry) as well as evaluative (e.g. I am good at chemistry) aspects of self-perception. Second, self-perceptions associated with academic self-concept tend to focus on scholastic competence, rather than attitudes. Showing there is no aspect of our lives that is not touched by chemistry. Irrespective of the great importance of chemistry to a developing country like Nigeria, it is disheartening to note that the students' achievement in the subject in senior secondary school certificate examination has remained consistently poor. This is supported by West Africa Examination Council (WACE) chief examiner's report of 2014. According to the report, the students' weaknesses among other are poor knowledge of the concept of "chemical bonding" (electronic configuration, oxidation state, IUPAC nomenclature). This poor achievement has generated concern for the researchers to carry out this study trying to know the impact of generative learning model (GLM) instrument strategy on academic self concept of secondary school students in chemistry.

Generative Learning Model (GLM) is a cognitive model of human learning with understanding that was developed by Wittrock, in 1974. It is a constructivist teaching strategy and instructional model that focused on cognitive processes that the students used to comprehend concept. GLM focuses on considering the students previous learning experience and understanding so that the learner can actively generate meaningful relationships between the prior knowledge and new information (Grabowski, 2007). The model provides students' opportunity for active participation in the learning process allows for group and individualized form of learning and empowers learners with ability to express their personal views

through its phases. GLM also explain that as we make connection between our existing schema and new information, our knowledge base changes and new information is formed. The generative theory of learning by Wittrock is based on the idea that learners can actively integrate new ideas into their memory to enhance their educational experience. In essence, it involves linking new with old ideas in order to gain a better understanding of the instructed concepts. This is unlike the conventional methods, which have no direction or phases, and the teacher talks, writes, and in fact do everything in the classroom. The GLM phases direct both teacher and students in learning environment. There are several versions of generative learning model as proposed by many researchers such as Baker (2001), Wittrock (1999), Bauer (2005) and Bybee, Buchwald, Crissman, Heel Kuerbis, Matsumoto and Nerney (1990). This study focuses on Bybee et tal (GLM) model. It is a teaching strategy with five instructional phases namely; engagement, exploration, explanation, elaboration and evaluation.

Teaching strategies are the techniques, methods and styles that a teacher can adopt to meet the various learning objectives. Teaching strategies include manner of presentation, the way of arranging conditions, grouping students, guiding activities and providing information to aid learning. Teaching strategies are central to the teacher's goal and strive to enrich the learning environment in which the learner is engaged. The learning environment is the total physical and mental world to which the students is exposed at a particular time, and the enrichment of the environment implies making the learning experience of the physical and mental world more conducive for the students. In addition, looking at today's age (computer age), students need to be taught with innovative teaching strategies. This is to enable them think critically, explore their environment, acquired the necessary attitude and skill to become future scientist. Therefore teachers of today need innovative teaching strategy in order to improve the academic self concept of secondary school student in chemistry, since is the starting point of students for future carrier in the field of science.Students academic achievement need to improve in chemistry by focusing students variables such as academic self concept which is likely to give necessary solution to the problem of poor achievement through use of generative learning theory. Generative learning theory was developed by

Wittrock (1999). It state that as we make connection between our existing schema and information, our knowledge base changes and new information is formed. The generative theory of learning by Wittrock is based on the idea that learners can actively integrate new ideas into their memory to enhance their educational experience. In essence, it involves linking new with old ideas in order to gain a better understanding of the instructed concept. The concept behind the generative learning theory lies on 'schemata' that is learning process is based on the memory that is already stored in our brains, According to Wittrock, (1999) human brain does not just passively observe its environment or the events it experiences, but that it constructs its own perception about problems, scenarios and experience. Wittrock further stated that "learner must be an active participant in the learning process, emphasizing on the importance of what the students does in order to learn is of greatest importance. The theory involves four key concepts that instructional designers can involve (all four of them or just one) depends on the needs of the learner and the learning materials involved. They are: recall, integration, organizer and elaboration.

Recall; this occurs when the learner accesses information stored in his long-term memory. Integration; involves the learner integrating new information with knowledge already collected and stored. Organization; it involves learner linking knowledge they have already collected to new concepts in an effective way. Elaboration; involves the encouragement of the learner to connect and add new concepts to information that they have already collected, by analyzing the ideas. Teacher's role knows how and when to facilitate the learners' construction of relationship making the learner and teacher or instructor partners in the learning process is their priorities. Teacher has the collaborative task of guiding and facilitating the students' activity. The teacher identifies the students by gathering the students conceptual, preconceptions about their learning the topic. Identify Preconceptions about their role as a learner, prior knowledge relating to the topic and Meta cognitive abilities. It encourages learners to become fully immersed in learning, so that they can develop new strategies on how to solve problems or scenarios. It involves teacher allowing the struggling students to interact with more capable ones, who continue to mediate transactions for the benefit of all. It memory to enhance their educational experience.

This theory has been one of the bases on which GLM is built upon. Since GLM of Bybeeettal emphasizes on engagement and exploration through which students identified prior knowledge and links it to concept to be learned. Therefore it is necessary to investigate the impact of generative learning model of Bybeeettal on students academic self concept in chemistry.

One wonders if student's academic self perception, confidence and effort (academic self concept) are considered in the conventional method employed by the teacher.These problems necessitated this study on the effect of GLM on academic self conceptof students in chemistry. Will GLM improve academic self concept of male and female students in chemistry? To provide answer to this question is the focus of this study.

Research Questions

The study provided answers to the under stated questions

1. What are the differences in the pretest and posttest mean self concept scores of students taught Chemistry with GLM instructional strategy and those taught with conventional method?
2. What are the differences in the pretest and posttest mean self concept scores of male and female taught Chemistry with GLM?

Hypotheses

The following null hypotheses were tested in the study at 0.05 level of significance

1. There is no significant difference in the mean self concept scores of students taught chemistry with GLM in Chemistry and those taught with conventional method.
2. There is no significant difference in the mean academic self concept scores of male and female students taught Chemistry with GLM.

Methodology

The study adopted a quasi – experimental, design specifically; a non-equivalent control group. It used a quasi experimental research design because participants' subject cannot be randomly assigned to experimental and control groups (Nworgu, 2008). Two intact classes were used in the study; one for experimental group and the other for control group. It is the study of effect of the systematic manipulation of one independent variable (GLM instructional strategy).

The study was carried out in Onitsha Education Zone of Anambra State. The zone has three Local

Government Areas (LGAs) which consist of Onitsha North, Onitsha South and Ogbaru. The study was conducted in secondary school at Onitsha North and Onitsha South LGAs which have 16 and 9 schools respectively. The choice of these LGAs is that they have large number of student communities and completely urban. The towns around these LGA are; Inland town, G.R.A., Nkpor, Fegge, and Woliwo.

The population consists of 2,194 chemistry students in Senior Secondary year one (SSI) in Onitsha North and South L.G.A. of Anambra State. There are 21 public secondary schools, 16 single sex and 5 co-educational schools located in the area. The students mean age is 14.00 minimum and 16.00 maximum with standard deviation of 1.33. SS I students were used because their academic self concept in chemistry need to be considered, built and improved in chemistry.Ninety eight (98) SS1 students were used for the study. Specifically, 50 students were used in experimental group and 48 students in control group (67 males and 31 females).

Instrument

The study involved the use of a measuring instrument titled Chemistry Self Concept Scale (CSCS). CSCS was developed and adapted by the researchers from the academic self concept inventory of Shavelson model in Joyce and Shirley (2007) and make it context specific. Ten questions derived from the inventory were modified to ten new questions which was constructed making the CSCS questions to 20. A four point rating scale, with the response options of Strongly Agree (SA) = 4, Agree (A) = 3, Disagree (D) = 2 and Strongly Disagree (SD) = 1. The instrument was divided into two section A and B. Section A sought the personal information of the students, which included sex, name of school and others. Section B is made up of 20 items which sought for information relating to the self confidence, effort and perception in class work of the students on chemistry concepts.

The CSCS was validated by two experts one from educational Psychology department and department of science education all from Nnamdi Azikiwe University Awka. A coefficient of 0.81 was obtain using Cronbach Alpha indicating that the instrument was reliable mean and standard derivation were used answer research questions. The hypotheses where tested at 0.05 of significance using Analysis of Covariance (ANCOVA).

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Results

The result and statistical analysis of the data obtained are represented in table.

Research Question 1: What are the mean differences in the pretest and posttestself concept score of students taught with GLM instructional strategy in chemistry and those taught with lecture method?

Table 1: Difference in the Means and Standard Deviations of Pretest and Posttest Self Concept Scores of Students in the Experimental and Control Groups

	Pretest Achievement			Posttest Achievement		
Group	N	Mean	SD	Mean	SD	Mean difference
Experimental	50	30.80	12.39	51.44	15.20	20.64
Control	48	33.56	13.70	33.12	13.60	0.43

The data on Table 1 show that the students taught with GLM (experimental group) had a mean self concept score of 51.44 in their posttest and a standard deviation of 15.21. While those taught with conventional method (control group) had a mean posttest achievement score of 33.56 with standard deviation of 13.60. The result indicated that experimental group had a mean difference of 20.64 while control group had a mean difference of 0.43. The various mean differences indicated that the experimental group had higher mean difference than the control group. This implies that the academic self concept of experimental group (GLM) improved more than control group (conventional method).

Research `Question 2: What are the differences in the pretest and posttest mean self concept score of male and female students exposed to GLM in Chemistry?

Table 2: Difference in Means and Standard Deviations of pretest and Posttest Self Concept Score of Male and Female Students in Experimental Group

		Pretest Achievement		Posttest Achievement		
Gender	**N**	**Mean**	**SD**	**Mean**	**SD**	**Mean difference**
Male	32	32.50	14.21	52.00	15.72	19.50
Female	18	27.78	7.72	50.44	15.15	22.70

The result in table 5 shows that the posttest means self concept score of male students is 52.00 with the standard deviation of 19.50. While the posttest means self concept score of female students is 50.44. The male mean difference (19.50) is less than the mean difference of the female students (22.66). This implies that female students' academic self concept is influenced and improved by GLM instructional strategy in Chemistry learning.

Hypothesis 1: There is no significant difference in the mean self concept scores of students exposed to GLM in Chemistry and those taught with expository method.

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Table 3: Analysis of Covariance (ANCOVA) of Students' Mean Self Concept Scores by Teaching Method and Gender

Tests of Between-Subjects Effects

Dependent Variable: self conceptposttest

Source of variation	type III Sum of Squares	df Square	Mean	F	Sig.
Corrected model	22872.eSS[3]	4	5718.160	98.887	.000
Intercept	1984.120	1	1984.120	34.312	.000
Prese	14608.126	1	14608.126	252.624	.000
Group	8960.683	1	8960.683	154.961	.000
Gender	122.633	1	122.633	2.121	.149
Group gender	4.966	1	4.966	.086	.770
Error	5377.769	93	57.825		
Total	205008.000	98			
Corrected Total	28250.408	97			

a. R Squared =.810(Adjusted R Squared =.801)

Table 3 indicates that the probability of obtaining the F- value (154.961) is 0.00, which is less than the 0.05 level of significance (P=0.00 < 0.05). The null hypothesis therefore is not accepted, which means that there is significant difference between the mean self concepts score of students taught chemistry with GLM and those taught with conventional in favour of the GLM group.

Hypothesis 2: There is no significant difference in the mean academic self concept scores of male and female students taught Chemistry using GLM instructional strategy.

Table 3 shows that the probability of obtaining the F- value 2.121 is 0.149 which is higher than the 0.05 level of significance(P = 0.149 < 0.05), therefore the null hypothesis is not rejected which means there is no significant difference between the mean achievement score of male and female students exposed to GLM instructional strategy.

Discussion

The findings of this study show that students taught Chemistry using GLM instructional strategy had higher mean

self concept score than students taught using conventional method. There is a significant difference between the mean self concept scores of experimental group (GLM) and control group (conventional method) in preference of experimental group with higher mean self concept score. This finding is in line with the finding of, Sare, Nielson and Ellen (2015), who were of the view that constructivist instructional strategy stimulates students' academic self concept to learn thereby achievement more than students taught conventional method.

The high self concept shown by the experimental group may have been the impact of the exploration and elaboration phases of the generative learning model. These phases are interesting on its own, in the sense that, this phase encourages individual student to explore ideas and apply what they have learnt. Due to these phases students effort, confidence and self concept which are a component of student academic self concept towards studying of chemistry may have been stimulated and sustained. The findings of this study reveal that male and female students taught chemistry with generative learning model instructional strategy have almost equal mean self concept scores. The findings show that there is no significant difference due to gender on chemistry students' means self concept scores. These findings are in agreement with the finding of Sare, Nielson and Ellen (2015) that no significant difference exist between mean self concept score of male and female students using science process skill teaching strategy. Majere (2013) also find that gender is not a significant factor in students' over all self efficacies in chemistry using metacognitive self assessments strategy. These finding agree with the findings of the present study.

Conclusion

From the findings above, the following conclusions were made.

This study has provided empirical data as it concerns the impact of (GLM) in teaching and learning of chemistry. The generative learning model (GLM) instructional strategy has significant impact on students' academic self concept in chemistry. The experimental group taught chemistry GLM has higher mean self concept score than the control group taught with conventional method.

Recommendations

Based on the findings of this study, the following recommendations were made:

1. Chemistry teachers should incorporate generative learning model as one of the instructional strategy used in teaching concepts in chemistry.
2. Counselors should organize orientation for Senior Secondary year one (SS1) students on science this will serve as a significant practical approach to explain to the students the importance of academic self concept in science learning.
3. The national Commission for Colleges of Education (NCCE) and Universities should ensure that in their teacher education programmes more emphases are laid on the usage of constructivist or innovative instructional strategy so that students teacher can have a model (GLM of Bybee et tal) in teaching of science.
4. Ministers of Education, both state and federal should sponsor teacher to attend Post graduate programmes. This is to make them improve and expose to innovative pedagogical science knowledge like (GLM) phases for effective teaching of science.
5. Generative Learning Model instructional strategy should also be used by chemistry teachers to enhance gender equity in academic self concept of all students in science

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