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EFFECT OF CONSTRUCTIVIST BASED INSTRUCTIONAL MODEL ON SENIOR SECONDARY STUDENTS' ACHIEVEMENT IN CHEMISTRY IN AWKA EDUCATION ZONE

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ABSTRACT

The quest to achieve effective teaching and meaningful learning in Chemistry prompted the study on effect of Constructivist-based instructional model (CBIM) on senior secondary students' achievement in Chemistry in Awka Education Zone. The main purpose of the study was to determine the effect of CBIM on SS2 students' academic achievement in Chemistry in Awka Education Zone. The study was guided by two research questions and three null hypotheses. The study adopted a quasi-experimental pre-test post-test non-equivalent control group design. One hundred and ten (110) SS2 students drawn from two schools were sampled using multistage sampling procedure. The Chemistry Achievement Test (CAT) constructed by the researcher was used for data collection which contained 50 multiple choice questions. The instrument was validated by three (3) experts –two from Science Education Department and one from Educational Foundations Department (Measurement and Evaluation) all from Nnamdi Azikiwe University, Awka. Kudder-Richardson Formula 20 (K-R20) was used to establish a reliability coefficient of 0.90. Mean and standard deviation were used to answer the research questions, while ANCOVA was used to test the null hypotheses. The findings revealed that CBIM significantly enhanced the achievement of students in Chemistry. Also, there is no significant gender difference on the effect of CBIM on students' academic achievement in Chemistry. Based on the findings of the study it was recommended among others that; Chemistry teachers should adopt CBIM when planning their lesson to enhance students' interaction with each other and the learning materials to facilitate retention, and Science Teachers Association of Nigeria (STAN) in collaboration with the government should organize seminars and workshops to orient Chemistry teachers on awareness and how to use CBIM in teaching and learning of Chemistry.

Keywords: Constructivism, chemistry, academic achievement and gender

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Introduction

Science education is the field of study concerned with sharing science contents and processes with individuals not traditionally considered part of the scientific community, thereby producing a scientific literate society (Al-Hmouz, 2019). Science education can be seen as a process of teaching and training especially in school to improve one's knowledge about their environment and develop skills for systematic enquiry. It is important to note that science education and its application in technology are one of the most powerful instruments which can aid all members of the society to face the dynamic nature of science and modernization of today of which Chemistry is a part of science.

Chemistry is one of the three main branches of pure science that deals with composition, properties and use of matter. Samuel & Obikezie, (2022), defined Chemistry as a branch of science, which deals with the study of composition and properties of matter, changes in matter, the law and principle that governs the nature. Chemistry is the scientific study of matter and its properties, the interaction between various forms of matter, and the transformation that matter undergoes. It involves the investigation of the structure and properties of molecules, their reactions with other molecules, and the synthesis and characterization of new compounds. According to Ahmed (2022), the benefits and contributions of Chemistry to our daily life and the world at large cannot be over-emphasized; ranging from providing solution to problems, health, food, agriculture, shelter, among others. Awodun, (2020), while stressing the importance of chemistry opined that Chemistry do not just start and end in the classroom or school as often perceived. Some phenomenon in Chemistry is practiced in our everyday activities outside the four walls of the school. Example of such activities which involves Chemistry practices are cooking of food, washing of clothes with detergent or soap, the process of boiling grinded fresh tomatoes to allow the liquid to get dried, addition of salt to perishable food stuffs in other to preserve them, the act of melting ice block into liquid water for the purpose of drinking to mention but few. These principles, concepts and facts of chemistry are also practiced in some industries such as food industry, petroleum industry, building industries, road construction industries and many others.

Despite the central position of Chemistry as a core science subject there is evident poor performance of students in Chemistry. According to the WAEC chief examiner "the WASSCE report on Chemistry from 2016 to 2022 indicates that the performance has been improving gradually, with more candidates obtaining good grades. However, the achievement of Chemistry candidate in grade C6-A1 from 2015 to 2021 revealed that in 2015, Chemistry students achievement in WAEC were 60.6%, 2016 = 57.74%, 2017= 62.68%, 2018= 61.95%, 2019=54%, 2020=59% and 2021=61.5%. From the figure it was observed that the percentage passes from 2015 to 2021 is not up to 70%. According to Adeniji (2021), for any nation to grow in technology the students' achievement in science related subjects like Chemistry must be at least 70%. He further asserted that the reason why most nations in some West African countries are still under developed is as a result of below distinctions on academics achievement of secondary school Chemistry

students in the external examination like WAEC and NECO. Could this poor performance of Nigerian Chemistry students in WASSCE and their Chemistry class exam be traceable to their methods of teaching models used in their schools?

Lecture method is one of the conventional methods of teaching; it involves majorly oral presentation of ideas. The teacher does most of the activities in form of talking while the students are passive listeners or slightly involved. This kind of method leads to rote learning. Lecture method is a kind of teaching method where the teacher remains the chief source of information (Joda, 2019). In this type of teaching approach, the teacher is the most active participant in the classroom hence also known as teacher-centered. Some methods of transferring knowledge to learners are passive rather than being active. As a result, students who have learning difficulties are unable to cope with how the lessons are delivered. Above average students are also disadvantaged because the lessons are not challenging enough. This means that students in either category are at an instant disadvantage compared to an average student without disability. This might have affected the achievement of students in Chemistry. Researchers such as Godpower and Owo (2019) recommended that teachers should endeavour to make use of innovative method. In the same vein, they agreed that persistent use of the Lecture method is one of the major short-comings affecting students' learning and achievement in science subjects especially in Chemistry.

Although, there are situations in which lecture method is inevitable. According to Joda (2019), Lecture method of teaching is necessary when the teacher wants to present new information or explain certain events of things. The method also becomes important when the teacher wants students to gain a better understanding of a topic or subject matter but where resources and time are limited. This is to say that lecture method allows for a wider coverage of subject content within a period of time and teaching large number of students at the same time.
These advantages of lecture method notwithstanding, achievement of students in Chemistry has not been encouraging. Following this, the present study attempted to focus on a teaching strategy that could be considered in order to guide the students of Chemistry for better understanding of the subject concepts. One of such methods that could enhance the interactive nature of the classroom is Constructivist based instructional model (CBIM).

Constructivist teaching is a teaching strategy which holds the view that knowledge are personally constructed and reconstructed by the learner based on his prior knowledge or experiences Amineh and Hanieh (2018). It is a strategy of learning based on the belief that knowledge is not a thing that can be simply given or transferred by the teacher in front of the classroom, to learners seated at their desks. Rather, knowledge should be constructed by the learners through an active mental developmental process. It also allows the students to interact with themselves, explore and work in groups, making meaning of tasks and setting out to solving problems that are perplexing to them (Kilavuz, 2015). Thus, the teacher's main focus should be on guiding students by asking questions that

will lead them to develop their own conclusions on the subject (Ibe, 2017). The constructivist classroom is characterized as follows: the learners are actively involved; the environment is democratic; the activities are interactive and student-centered and the teacher facilitates a process of learning in which students are encouraged to be responsible and autonomous.

Gender is a moderating factor that has been examined in this study. A number of studies have demonstrated the discrepancy between male and female students. Ajayi and Ogbeba (2017), observed that the interaction between methodology and gender has no significant impact on students' achievement in science. Additionally, Ahmed (2022), demonstrated that there is no significant difference in the achievement of male and female students in science. While Akinyemi and Folashade (2010) observed that female students performed significantly better than their male counterparts in Chemistry. To this end this study sought to investigate the effect of Constructivist based instructional model on students' academic achievement using gender as moderating variable.

Statement of the Problem

One of the major challenges facing education in Nigeria is the general poor performance of students in science subject which may be due to the method of teaching. Poor performance in science, particularly Chemistry, at senior school certificate examination has persisted over the years. Some prominent factors adduced for poor performance include insufficient number of qualified science teachers, inadequate Chemistry equipment's and laboratories, lack of incentives for teachers, poor primary school science background and poor teaching method.

Although many reasons have been pointed out by various researches on the cause of low achievement in Chemistry, there is still need for further investigation. This may be because science teachers and the school management had been the major area of focus without considering the facts that students come to Chemistry class with some learning difficulties which are often in conflict with scientific ideas.

Some research has shown that method of instruction mostly used by Chemistry teachers is teacher-centered and many of them do not vary their teaching methods. This study, therefore, investigates the effect of Constructivist-based and Objectivist-based instructional model on students' academic achievement and retention in chemistry concepts.

Literature Review

The study is anchored on Lev Vygotsky's Social Learning Theory. Lev Semyonovich Vygotsky a psychologist is considered the father of modern constructivism states that learning is a collaborative process and that the development of a student's intelligent output from social interaction in the environment and speech, social interaction and co-operative activities are all important aspect of the social world. He suggested that learning takes place through the interactions students have with their peers, teachers, adults and other experts. Consequently, teachers can create a learning environment that maximizes the learner's ability to interact

with each other through discussion, collaboration, and feedback.

Vygotsky theory is related and relevant to the present study in the sense that a student does not learn in isolation. Part of the activities that sticks knowledge longer in the memory of the learners is group activities. In essence, Vygotsky recognizes that learning always occurs and cannot be separated from a social context. The social atmosphere may involve student-student and teacher-student collaboration on real world problems or tasks that build on each person's language, skills, and experience shaped by each individual's culture. Consequently, instructional strategies that promote distribution of knowledge where students collaboratively work together to conduct research, share their results, and perform or produce a final project, help to create a collaborative community of learners. This interaction provides opportunities for modeling of reasoning patterns of thinking strategies and problem solving skills.

Vygotsky's theory requires that students and teachers play untraditional roles and collaborate with each other. Instead of a teacher dictating their meaning to students for recitation, a teacher should collaborate with the students to create meaning in ways through which students can understand on their own. The social constructivist approach in chemistry emphasizes that learning occurs when students share their understanding through classroom discussion and by exchange of ideas.

Constructivist view of knowledge, teaching and learning

Constructivism is a synthesis of multiple theories diffused in to one form. It is the assimilation of both behaviorist and cognitive ideas. The "constructivist stance maintains that learning is a process of constructing meaning; it is how people make sense of their experience". Amineh and Hanieh (2018) state that constructivism is widely touted as an approach to probe for children's level of understanding and to show that understanding can increase and change to higher level thinking. Thus, constructivism refers to the how of learning and thinking. Constructivism describes the way that the students can make sense of the material and also how the materials can be taught effectively.

Constructivism as a paradigm or worldview posits that learning is an active, constructive process with the learner being an information constructor and actively constructing or creating their own subjective representations of objective reality and that new information is linked to prior knowledge, thus mental representations are subjective **(**Ikechi, 2018). Very simply, constructivism states that learning is an active, contextualized process of constructing knowledge rather than acquiring it.

Constructivism is an approach to teaching and learning based on the premise that cognition (learning) is the result of "mental construction." In other words, students learn by fitting new information together with what they already know. Constructivists believe that learning is affected by the context in which an idea is taught as well as by students' beliefs and attitudes. Constructivism is a learning theory found in psychology which

explains how people might acquire knowledge and learn. It therefore has direct application to education. The theory suggests that humans construct knowledge and meaning from their experiences. Constructivism is not a specific pedagogy.

2.3.1 (I) Constructivist view of learning: Due to complexities and diversity of perspectives on constructivism, Ikechi (2018) introduces a common set of principles for these perspectives that can be operationalized. Hoover expressed two important notions which encompass the simple idea of constructed knowledge. The first notion is that learners construct new understandings using their current knowledge. In other words, the learners' prior knowledge influences their new knowledge. The second notion is that learning is not passive. Instead learning is an active process in which learners negotiate their understanding in the light of what they experience in the new learning situation. If what learners encounter is not consistent with their current understanding, their current knowledge can change in order to accommodate new experience. Thus learners cannot be passive and they remain active throughout this process.

In constructivism, learning is represented as a constructive process in which the learner is building an internal illustration of knowledge, a personal interpretation of experience. This representation is always open to modification, its structure and linkages forming the ground to which other knowledge structures are attached. Learning is then an active process in which experience has an important role in understanding and grasping the meaning. This view of knowledge does not necessarily reject the existence of the real world, instead it agrees that reality places constrains on the existing concepts, and contends that all individuals' knowledge of the world is the interpretations of their experiences. Furthermore, conceptual growth is the result of various perspectives and the simultaneous changing of individuals' internal representations in response to those perspectives as well as through their experience.

Amineh and Hanieh (2018) point out that constructivism is a learning theory in which learning is both an active process and a personal representation of the world. In this theory, knowledge is constructed from the experience and is modified through different experiences. Problem solving and understanding are emphasized in this theory. Authentic tasks, experiences, collaboration, and assessment are among other important factors in this view of learning.

Scope of the Study

The study is delimited to finding out students' achievement using Constructivist based instructional model and Lecture method. The study focused on senior secondary year two (SS2) students in Chemistry in Awka, Anambra State. The SS2 student were chosen because they have opted out from offering too many other subjects and are now focused on science related subjects.

Purpose of the Study

The purpose of this study is to determine the effects of Constructivist-based instructional model (CBIM) on Students' academic achievement in Chemistry. Specifically, the study sought to:

1. Determine the difference in the mean achievement scores of student taught Chemistry with CBIM and those taught with LM.
2. Determine the difference between the mean achievement scores of male and female student taught Chemistry with CBIM and those taught using LM
3. Determine the interaction effect of instructional models and gender as measured by the mean achievement scores

Research Questions

The following research questions were formulated to guide the study.

1. What is the difference in the mean achievement scores of student taught Constructivist-based instructional model (CBIM) and those taught with Lecture Model (LM)?
2. What is the difference in mean achievement score of male and female students taught using CBIM and those taught using LM?

Null Hypotheses

The following null hypotheses were stated at 0.05 level of significance.

1. There is no significant difference in mean achievement score of students taught using CBIM and those taught using LM.
2. There is no significant difference in the mean achievement scores of male and female student taught Chemistry using CBIM and those using LM
3. There is no interaction between instructional models and gender as measured by the mean achievement scores

Research Method

The design adopted for the study is pretest-posttest non-equivalent control group quasi-experimental design. The population of the study comprised 2466 SS2 Chemistry students in the 64 public secondary schools in Awka education Zone of Anambra State. The sample of the study was 110 students drawn by simple random sampling technique from two schools in two intact classes by criterion sampling technique. Chemistry Achievement Test (CAT) instrument was used for data collection. It was a fifty item Chemistry Achievement Instrument which was validated by three experts, two from the Department of Science Education and one from Measurement and Evaluation Unit all from Nnamdi Azikiwe University, Anambra State. The reliability of the instrument was 0.90 determined by Kuder Richardson test.
The CAT was first administered as pretest to students' before the commencement of the treatment using prepared lesson plans both for the experimental and control groups: to determine the students' prior knowledge and academic equivalence. After the pretest administration, the instrument was reshuffled and used as posttest to determine the effect of Constructivist-based instructional model on students' achievement in those selected topics. The pretest was administered on the first week; posttest was administered on the sixth week after the treatment had been used. The experimental groups were taught using constructivist based instructional model by their teacher who was a research assistant

under the following headings: water, hard water, acids and base according to the senior secondary chemistry curriculum. The research assistant gave room for discussions, student's activities, questions and answer sessions while the control group were taught using Lecture method by their teacher who also was a research assistant.

Presentation of Results

Research Question 1: What is the difference in the mean achievement scores of student taught with Constructivist-based instructional model (CBIM) and those taught with Lecture method (LM)?

***Table* 1: Pre-test and Post-test Mean Achievement scores of students taught Chemistry using CBIM and LM**

		Pre-test		Post-test		
Groups	**N**	**Mean**	**SD**	**Mean**	**SD**	**Mean difference**
Experimental	60	42.13	12.13	51.78	9.96	-9.65
Control	50	42.28	10.43	44.48	10.87	-2.20
Mean Difference		-0.15		07.30		7.45

Results in table 1 reveals that the students taught Chemistry using CBIM pre-test mean achievement score of 42.13 and post-test mean achievement score of 51.78 with mean difference of -9.65, while those in the control group taught with LM has pre-test mean achievement score of 42.28 and post-test mean score of 44.48 mean difference of -2.20. Students taught Chemistry using CBIM had a low spread of scores in the post-test (9.96) than those in the LM (10.87) indicating that students taught using CBIM had a more homogeneous score in their post-test.

Research Question 2: What is the difference in mean achievement score of male and female students taught using CBIM and those taught using LM?

***Table* 2: Pre-test and Post-test Mean Achievement Scores of Male and Female Students taught Chemistry using CBIM and LM**

		Pre-test		Post-test		
Gender	**N**	**Mean**	**SD**	**Mean**	**SD**	**Mean difference**
Male	45	42.67	11.64	50.20	10.24	-7.53
Female	65	41.88	11.20	47.26	11.36	-5.38
Mean Difference		0.79		2.94		-2.15

Table 2 reveals that the male students taught Chemistry using CBIM had pre-test mean achievement score of 42.67 and post-test mean achievement score of 50.20 with a mean difference of -7.53 while the female students have pre-test mean score of 41.88 and post-test mean achievement score of 47.26 with a mean difference of -5.38. There

was a higher spread of scores among the female students in the post-test (11.36) than among the males (10.24) indicating that the male students had a more homogeneous score in the post-test.

Hypothesis 1: There is no significant difference in mean achievement score of students taught Chemistry using CBIM and those taught using LM.

***Table* 3: ANCOVA Test of Significance of Difference between the Mean Achievement Scores of Students taught Chemistry using CBIM and LM.**

Tests of Between-Subjects Effects

Dependent Variable: POSTTEST

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	4320.319[a]	4	1080.080	12.915	.000	.330
Intercept	6681.310	1	6681.310	79.892	.000	.432
PRETEST	2524.002	1	2524.002	30.181	.000	.223
GENDER	143.952	1	143.952	1.721	.192	.016
METHODS	1515.597	1	1515.597	18.123	.000	.147
GENDER * METHODS	52.610	1	52.610	.629	.429	.006
Error	8781.036	105	83.629			
Total	271461.000	110				
Corrected Total	13101.355	109				

Table 3 shows that there is a significant main effect of the treatment on students' achievement in Chemistry P = 0.000 < 0.05. Therefore, the null hypothesis is rejected meaning that there is a significant difference between the mean achievement scores of students taught Chemistry using CBIM and those taught using LM.

Hypothesis 2: There is no significant difference in the mean achievement scores of male and female student taught Chemistry using CBIM and those using LM.

ANCOVA Test of Significance of Difference between the mean achievement scores of male and female student taught Chemistry using CBIM and those using LM.

As presented in the ANCOVA Table 3, findings shows that the p-value is greater than the significant level having F value =1.721, P= 0.192 > 0.05. Therefore, the null hypothesis is not rejected meaning that there is no significant difference between the mean achievement scores of male and female students taught chemistry using CBIM and those using LM.

Hypothesis 3: There is no interaction between instructional models and gender as measured by the mean achievement scores.

Based on the ANCOVA result shown in table 3, the p-value for the interaction between gender and methods shows it is greater the significant level, where F value 0.629, P= 0.429 > 0.05. Hence, the null hypotheses is not rejected, there is no significant interaction between gender and instructional models on academic achievement scores of students.

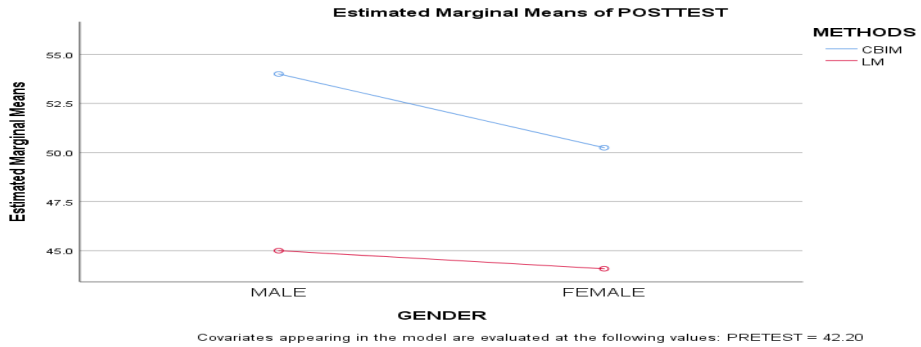


Figure 1: plot interaction between instructional models and gender

The plot, is a pictorial view of the interaction effect between the two instructional models and gender. It shows, there is no interaction between instructional models and gender in this study.

Conclusion

Based on the findings of this study, it was revealed that constructivist-based instructional model has a positive significance on the academic achievement of students. Similarly, the analysis showed that there is a moderate positive relationship between male and female secondary school students' academic achievement in Chemistry

Recommendations

1. Chemistry teachers should adopt CBIM while planning their lessons to enhance students' interaction with each other and the learning materials to facilitate effective learning and retention
2. The Science Teachers Association of Nigeria in collaboration with the government should organize seminars and workshops to train teachers on how to use CBIM in teaching and learning of Chemistry and other science subjects.
3. Teachers training institutions should incorporate CBIM during the teaching and learning process to instill in pre-service teachers the knowledge and skills needed to effectively employ the strategy in the classroom

REFERENCES

Al-Hmouz, H. N. (2019). Investigating the effect of constructivism on chemistry Achievement: A meta-analytical study. *Journal of Chemistry Education Research and Practice*, 20(1), 116-127.

Ahmed O.Q. (2022). *The Effect of using the Learning Cycle Method in teaching Science on the educational achievement of the sixth graders*. Int. J. Educ. Sci. 4(2):123-132.

Amineh, R. J. and Hanieh D. A. (2015). Review of Constructivism and Social Constructivism. *Journal of Social Sciences, Literature and Languages* Vol. 1 No.1, pp 9-16

Akinyemi, O. A and Folashade, A., 2010. *Constructivist practices through guided discovery approach: The effect on students' cognitive achievement in Nigerian senior secondary school Physics.* Eurasian J. Phys. Chem. Educ. 2,(1): 16-25.

Adeniji A.G. (2021). Science and Technology Education in Secondary Schools: Need for Manpower Development. *Journal of the Science Teachers Association of Nigeria*, (40)1 & 2: 63-67.

Ajayi, O. V. and Ogbega, J. (2017). Effect of gender on senior secondary school chemistry students' achievement in electronic works trade using hands-on activities. *American Journal of Educational Research, 5*(8), 839-842

Awodun, A. O. (2020). Effects of Constructivist based Instructional Model on Students' Academic Achievement in Secondary School Physics in Ekiti State, Nigeria. *International Journal of Scientific Development and Research (IJSDR), 5*(8), 470-476

Godpower-Echie, G., and Owo, W. J. (2019). Gender Differences in Basic Science Achievement of Private Junior Secondary School Students in Obio/Akpor Local Government Area, Rivers State. *International Journal of Scientific Research in Education, 12*(2), 320-329. Retrieved from http://www.ijsre.com

Ibe, H. N., 2016. Science teachers' evaluation of students using higher order thinking skills (HOTS) of revised blooms cognitive taxonomy. *Nigerian Journal of Social Review*, 4, (2): 75-85.

Ikechi, O. (2018). Academic Achievement of Students in Basic Science among Secondary Schools in Rivers State: Synergy of Parents" Educational Background, Socio- Economic Status and School Location. *International Journal of Science and Research* 7(1) 1185-1192

Joda, F. M. (2019). Effects of Instructional Scaffolding Strategy on Senior Secondary Biology Students' Academic Achievement and Retention in Taraba State, Nigeria. *The Asian Institute of Research Education Quarterly Reviews 2*(2) 269-275

Kilavuz Y (2016). *The effects of 5e learning cycle model based on constructivist theory on tenth grade students' understanding of acidbase concepts*. Unpublished Master

Thesis of Middle East Technical University, Ankara.

Samuel, N.N. C. (2021). Comparative effects of concept mapping and simulation-game teaching Strategies on students' interest in environmental concepts in chemistry. *Unizik Journal of STM Education, 4(1), 76-87. Retrieved from https://journal.unizik.edu.ng/index.php/jstme/article/view/1471*

Samuel, N.N. C. and Obikezie, M.C. (2022). Effects of Laboratory practical work and Demonstration Method on Students Achievement and Interest in Chemistry. *STEM Journal of Anambra State (STEMJAS),* 4(1); 2022.

Vygotsky L. 1986. Thought and Language. Transl. and ed. A. Kozulin. Cambridge, MA: The MIT Press. (Originally published in Russian in 1934.)