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Effects of Cooperative Learning and Lecture Instructional Approaches (Clia and Lia) On Conceptual Change of Chemistry Students in Delta North Senatorial District

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Abstract: *Effects CLIA and LIA on conceptual change of chemistry students in Delta North Senatorial District were examined in this study. The study adopted planned variation group quasi-experimental design. The population for the study consisted of 6, 725 students. 302 SSII students made up the sample. Two-Tier Chemistry Test (TTCT) was the study's instrument. Three professionals face-validated TTCT. TTCT had 0.79 reliability value established using Kuder-Richardson formula 21. t-test and ANCOVA were used to analyse the students' scores obtained from pre- and post-tests. The results showed significant difference between the mean conceptual change scores of students taught chemistry using CLIS and LIA, in favour of CLIS. The conclusion drawn based on the findings of the study is that CLIS has a relative advantage and bears more beneficial boost than LIA in enhancing students' conceptual change in chemistry. According, the adoption of CLIA by teachers in during chemistry instruction at the senior school was recommended.*

Keywords: Cooperative Learning Instructional Approach (CLIA), Lecture Instructional Approach (LIA), Conceptual Change

Introduction

The cultural heritage of every nation is passed on from generation to generation through education. Education is transmission of knowledge, attitude and skills to individuals in order to effectively integrate these individuals into the society. In order to educate these individuals, they are exposed to different subjects including chemistry. The science of chemistry examines the constitution, characteristics, and reactions of matter. It deals with the investigation of substances, their components, properties and reactions, and the use of products (new substances) of such reactions.

Chemistry has a significant impact on national development. The importance of chemistry in a country's growth cannot be overstated, according to Akudo (2018), particularly in Nigeria, where the petroleum and petrochemical sectors provide the majority of the country's wealth. The drive for global sustainable economic development is centred on chemistry. Food, clothing, housing, medicine, transportation, and many more products like cosmetics, paints, soaps, and so forth all rely heavily on chemistry. Additionally, there are numerous occupations in chemistry, including those in the medical field, the food industry, the extractive industry, the petroleum and petrochemical industry, and others.

Despite the importance of chemistry, students' performance in the subject in external examination has fallen short of expectation. Specifically, review of chemistry students' performance in WASSCE has been appalling (WAEC Chief Examiner Reports, 2015-2020). This underachievement of students in chemistry may be linked to the method of teaching chemistry teachers adopted among others. Based on the large number of topics to be covered, large number of students per class and time bound in the Nigeria academic system, chemistry teachers widely use the lecture instructional approach. LIA is the verbal presentation of lessons to students by the teacher. The LIA is referred to as a "talk-chalk" method by Ajaja (2016). According to Ajaja (2016), the LIA may be used for courses of any size, however it is typically utilised for big classes. The fact that the LIA fosters completion of subject matter content within a set amount of time is the foundation for its acceptance by teachers. A teacher-centered approach to teaching and learning known as LIA views the teacher as an authority who imparts knowledge to students who have little to no input into the lesson. Although LIA promises that the course outline will be finished on schedule, it also pushes students to memorise and repeat lessons rather than to ingest and assimilate their lessons. In other words, LIA does not promote students' positive conceptual change. This may be one of the cause of students' poor performance in chemistry in external examinations. To facilitate students' easy understanding of chemistry concepts, the use of CLIA and other active teaching strategies have been recommended by scholars (Ajaja, 2013; Agogo & Onda, 2014).

CLIA is considered as a teaching method in which a small group of students collaborate to complete a task for each member of the group as well as for the group's overall objectives. Effective cooperative group learning requires two components. These components include individual accountability and group objectives. Students can work together to attain group goals in order to receive prizes or recognition, and the success of the group depends on the individual growth of each member (Offiah & Okonkwo, 2011). Individual responsibility, group learning with individual performance. This makes it possible to view other people's work. In individual accountability, a lesson's objective must be sufficiently clear for students to be able to assess whether the group or any one member is effective in accomplishing it. The crux of this study was to determine the extent CLIA can help improve students' achievement in chemistry in Senior Schools.

CLIA is a methodical and planned strategy to employ small groups to improve interdependence and learning in pupils. Students collaborate to complete tasks, often known as assignments, that are handed to them. Success depends on the efforts of every member of the group since each one is held accountable for their part in assisting in the completion of the assignment. It is a way of learning that encourages teamwork among the individual learners. CLIA is a teaching strategy in which students collaborate in small, heterogeneous groups to finish a project or other educational objective while teachers serve as mentors or facilitators (Johnson, Johnson & Smith, 2001).

CLIA is an instructional strategy that encourages social interactions and experiences that can mould people's cognitive processes in a learning environment, according to Ayhan and Yasemin (2006). Additionally, they argue that cooperative learning contributed to the creation of knowledge and the translation of multiple points of view into personal thinking. Based on scientific facts, CLIA is an effective teaching-learning method for a variety of courses (Ajaja, 2013; Agogo & Onda, 2014). By giving students a means of extending and applying their knowledge in a way that links with their interests within a broad thematic framework, CLIA enhances conventional training. It is a technique for teaching science and math that involves asking questions, looking for answers, learning about phenomena, and gathering evidence before drawing a conclusion (Sola & Ojo, 2007). Students develop social skills, self-direction, and responsibility in the CLIA setting in addition to academic concepts. Additionally, it enables students to take in and integrate knowledge. When people are left alone, they learn in this manner. According to Ajayi (2002), cooperative learning is crucial for the creation and dissemination of information. It supports pupils' development of inquiry and idea construction skills.

Therefore, the study proposed that CLIA may bear more beneficial boost on students' conceptual change than the conventional lecture method. According to Nadelson, Heddy, Jones, Taasoobshirazi and Johnson (2018), Building on an existing conception to create a new explanation while keeping the previous extant conception's explanation is referred to as conceptual transformation. When students are exposed to new material that contradicts their preconceived notions, they must go through a process of accommodation that results in conceptual transformation. The teaching method adopted by the teacher can facilitate conceptual change in students. Therefore, the study sought to explore if the use of CLIA will facilitate students' conceptual change in chemistry than LIA.

In addition to inappropriate teaching method, students' sex has also been identified as a factor affecting students' conceptual change in chemistry. Though sex is a moderator variable in this study, it is the state of being a male or female student. The understanding of the relationship between sex and instructional methods is paramount in the choice of teaching method for chemistry instruction so that a teacher would not adopt a teaching method that favours one sex better than the other (i.e., favour male than female or vice versa). Thus, the study further explored the interaction of CLIA and sex on students' conceptual change in chemistry.

Statement of the Problem

Students' poor chemistry achievement in WASSCE has led to public outcry. WAEC Chief Examiner's reports on chemistry from 2015-2020 further re-affirmed the same trend of students' poor achievement in chemistry. The report shows that great percentage of the students that sat for WASSCE where not able to have credit pass in chemistry. In addition, the reports showed that students are unable to answer questions relating to radioactivity, calculations on half-life, relative abundance and binding energy. The cause of the appalling chemistry achievements may be connected to poor instructional approaches chemistry teachers used among the many other factors that have been implicated in literatures.

The LIA commonly used in Nigeria secondary schools does not promote conceptual change as well as cater for the different learning needs manifested by chemistry students. The LIA also does not encourage students' active involvement and interaction during the teaching and learning process. The chemistry teachers are more focused on fulfilling the need of the curriculum or covering the scheme of work for each term than ensuring that students learn effectively. The lack of attention to the students' academic needs and students' passivity during the process of learning may have accounted for the continuous decline in students' achievement in chemistry. As a result, it is necessary to experiment with alternate instructional approaches like CLIA, which: meet the needs of diverse learners, enhance group learning and interaction; and enhance students' self-discovery of knowledge using the science process skills during the teaching-learning process. CLIA not only takes into consideration the academic needs of students, but it equally ensures that students of varied ability levels learn together in the same group. The problem of this study, therefore, is: will CLIA enhance conceptual change of students more than LIA?

Purpose of the Study

The study's goal was to ascertain how CLIA and LIA affected the conceptual change of chemistry students in the Delta North Senatorial District. In particular, the study:

1. examined the difference between the mean conceptual change scores of students taught chemistry using CLIA and LIA.
2. identified the nature of the interaction of instructional approaches and sex on students' conceptual change in chemistry.

Hypotheses

1. There is no discernible difference between students taught chemistry using CLIA and LIA in terms of their mean conceptual change scores.
2. There is no significant interaction effect between instructional approaches and sex on students' conceptual change in chemistry

Research Method

The study employed planned variation group quasi-experimental design. The population compried 6, 725 chemistry students in public senior schools in Delta North Senatorial District. 302 SSII chemistry students in eight public mixed secondary school intact classes made up the sample. The eight intact classes were selected using stratified random sampling technique. Two-Tier Chemistry Test (TTCT) was used for data collection in the study. Two-Tier Chemistry Test (TTCT) was face-validated by three experts. The two-Tier Chemistry Test (TTCT) was further content and construct validated by the researcher. The reliability of the Two-Tier Chemistry Test (TTCT) was established using Kuder-Richardson formula 21 approach. 30 SSII Chemistry students in a secondary school in the Uvwie Local Government Area who were not enrolled in one of the study's sampled schools were given the TTCT. The performance of the 30 students was initially scored for only the first stage (for achievement) and later for the first and second stage (for conceptual change) of Two-Tier Chemistry Test (TTCT) and analyzed using Kuder-Richardson formula 21. On analysis, a reliability coefficient of 0.79 was established for the first stage of TTCT for achievement and 0.85 for the first and second stage of TTCT for conceptual change.

This quasi-experimental study consisted of two groups; cooperative learning and lecture groups. The treatment in this study involved instructing students on some selected concepts in chemistry using CLIA for the cooperative group, and the students in the lecture group were taught using LIA. Pre-test and post-test were administered before and after treatment with the aid of TTCT. T-test and Analysis of Covariance (ANCOVA) were used to analyse data.

Results

There is no discernible difference between students taught chemistry using CLIA and LIA in terms of their mean conceptual change scores,

Table 1

t-test Comparison of Conceptual Change Scores of Students Taught Chemistry with CLIA and LIA

Group	N	Mean	SD	df	t-cal	sig. (2-tailed)	Decision
CLIA	157	59.32	13.24	300	4.553	0.000	Significant
LIA	145	52.48	12.83				

P<0.05

Table 1 indicates considerable difference between the mean ($\bar{x}$) conceptual change scores of students taught chemistry using CLIA and LIA, t_{cal} = 4.553, P(0.000) < 0.05. Thus, the null hypothesis is disproven. Therefore, The mean conceptual change scores of students taught chemistry using CLIA and LIA differ significantly, favouring CLIA.

- There is no significant interaction effect between method and sex on students' conceptual change in chemistry.

Table 2

ANCOVA Summary on Interaction Between Approaches and Sex on the Conceptual Change of Students

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	3946.181[a]	4	986.545	5.784	.000
Intercept	103125.953	1	103125.953	604.572	.000
Pretest	71.881	1	71.881	.421	.517
Methods	3158.899	1	3158.899	18.519	.000
Sex	24.443	1	24.443	.143	.705
Methods * Sex	303.985	1	303.985	1.782	.183
Error	50661.342	297	170.577		
Total	1003024.000	302			
Corrected Total	54607.523	301			

Table 2 indicates no significant interaction effect of instructional approaches and sex on students' conceptual change in chemistry, F(2, 297) = 1.782, P(0.183) > 0.05. The null hypothesis is therefore not disproved. In light of this, method and sex have no discernible effect of interatction on how students conceptualise chemistry.

Discussion of Results

The study revealed noteworthy difference between the mean conceptual change scores of students taught chemistry using CLIA and LIA, in favour of CLIA. This observation may be ascribable to students' level of participation and interaction with materials offered by CLIA and LIA. Students taught chemistry using CLIA may have been more involved during the learning process than their counterparts taught using the LM. CLIA promotes the identification and remediation of students' misconception leading to a positive conceptual change during instruction. This is not the case for the LM where information about chemistry concept is passed to students without paying attention to students' misconception. This could be the reason why CLIA-taught chemistry students significantly outperformed LM pupils in terms of conceptual change scores. This result supports the findings of Laksana, Dasna, and Degeng (2019), who found that cooperative inquiry-based learning significantly improved students' conceptual knowledge compared to direct instruction.

The study further revealed significant interaction effect between method and sex on students' conceptual change in chemistry. This implies that the effect of CLIA and LIA on students' conceptual change is not moderated by students' sex. In other words, CLIA and LIA did not combine with students' sex to influence their conceptual change in chemistry. This finding is in line with that of concurs with that of Ajaja (2013) who reported a non-significant interaction effect between sex and teaching method (cooperative learning) on students' achievement in integrated science.

Conclusion

The study concludes that CLIA is an effective instructional strategy for boosting students' positive conceptual change in chemistry. The use of CLIA has a relative advantage and bears more beneficial boost than LIA in positively boosting students' conceptual change. The study concludes that CLIA have the potential for ensuring that students' conceptual change in chemistry can be uniformly boosted for both male and female students.

Recommendations

The researcher recommended the following in light of the findings of this study:

1. Chemistry teachers' acceptance of CLIA in the instruction of senior-level chemistry ideas.
2. During chemistry lessons, chemistry teachers should make an effort to pay close attention to students' misconceptions in order to support good conceptual transformation.
3. In order to make it easier for secondary schools to follow conceptual change directions, the government should also provide enough learning resources.

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