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EFFECTIVENESS OF COOPERATIVE LEARNING AND CONCEPTUAL CHANGE STRATEGIES IN IMPROVING LEARNING OUTCOMES OF PROSPECTIVE TEACHERS WITH DIFFERENT RELIGIOUS INCLINATION

Delphonso Bamidele Tokunbo (PhD)

*School of Science, Department of Integrated Science, Michael Otedola College of Primary
Education, Noforija, Epe, Lagos, Nigeria*

Delphonsobamidele@gmail.com

Abstract

The study examined the Effectiveness of Cooperative Learning and Conceptual Change Strategies in improving Learning Outcomes of College of Education Biology Students. The study adopted a non-equivalent pre-test, post-test control group design. The study population comprised Part III Biology Education students in colleges of education in Southwestern Nigeria. Two instruments were used to collect data for the study. The first instrument is ATE and retention test. The second instrument is AQE. The data collected were analysed using ANOVA and ANCOVA). The results indicated that the CLS was more effective in improving the performance of Biology education students with Christian, Islamic and traditional religious belief systems more than the CCS, there was a significant difference between the CLS group pre-test and CLS group post-test (Mean difference = 18.14, $p = 0.000$). Also, there was a significant difference in the CCS group pre-test and post-test (Mean difference = 10.155, $p = 0.000$). Moreover, there was also a slight significant difference in the TEM pre-test and post-test scores (mean difference = 6.500, $p = 0.036$). Therefore, the hypothesis was rejected. However, if the mean difference between the pretest and the posttest in the three groups were compared,

the CLS group has the highest (18.14), CCS group was 10.15, while the TEM group has the lowest (6.500). Moreover, when the means of the groups were compared, the CLS group has the highest mean score (58.02) and the CCS group mean score was 52.05. This is an indication that the CLS group has more positive effect on performance of students in evolution. However, result indicated that there was a significant difference in the attitude of students in the CLS and CCS groups before and after treatments. This implies that the two strategies (Cooperative Learning Strategy and Conceptual Change Strategy) caused the students to have a change of attitude towards the concept of evolution and most importantly their religious inclination no longer distorts scientific facts.

Keywords

Achievement Test on Evolution (ATE), Attitudinal Questionnaire on Evolution (AQE), Analysis of Variance (ANOVA), Analysis of Covariance (ANCOVA), Cooperative Learning Strategy (CLS), Conceptual Change Strategy (CCS), Teacher Expository Method (TEM)

1. Introduction

Biology occupies a unique position in the national school curriculum in Nigeria. It is a science subject that is offered across the streams of classes at the senior secondary school level. The subject is central to many science related disciplines; hence it is a required subject for entry into such professions and careers of Medicine, Pharmacy, Agriculture, Nursing, Microbiology, Biotechnology, Biochemistry, Food Science and Technology, etc. Therefore, students who intend to take up careers in these disciplines are expected to pass Biology at credit level in the national examinations. However, in spite of the importance and popularity of the subject among Nigerian students, studies have shown that students lack interest, competence and the right attitude required to learn the subject effectively (Ajaja, 2002; Aladejana, 2008 and Salami, 2012).

This has resulted in the poor performance of the students in the subject in recent years. As a result of this low performance in Biology and in the core science subjects generally, only very few students would be able to secure admission into science related courses like Medicine, Agriculture, Pharmacy, Geology, e.t.c in higher education institutions.

A positive attempt to improve students' learning of Biology concept will therefore involve the use of strategies that are tailored towards constructivism that will help to modify students' misconceptions. The process of modifying misconceptions with scientifically acceptable concepts is called "conceptual change". Constructivism is one of the pedagogical

tools used to promote conceptual change among learners. This will consequently have a great implication on investment in human capital, manpower development, scientific advancement and technological attainment of the country. This situation calls for serious concern, and suggests that Science Education in Nigeria needs a serious re-assessment such that will re-focus the attention of researchers in the area of science teaching.

2. Theoretical Framework

The theoretical framework of this study is based on constructivist theory. A basic assumption in teaching for conceptual change is “the key constructivist idea that construction of new conceptions (learning) is possible only on the basis of already existing conceptions.

Piaget’s Genetic Epistemology is fundamentally constructivist. It emphasizes that assimilation, accommodation, disequilibrium and equilibrium are important components in the conceptual change process. Von Glaserfeld (1988) describes constructivism as a theory of knowledge which is rooted in philosophy, psychology and cybernetics. Yager (1991) claims that constructivist theory of knowing and ability to cope depends on equilibrium state while the equilibrium is like a balance beam. According to Slavin (1987), there are two major theoretical perspectives related to cooperative learning -- motivational and cognitive. The motivational theories of cooperative learning emphasize the students' incentives to do academic work, while the cognitive components emphasize the effects of working together.

Social Constructivism is a variety of cognitive constructivism that emphasizes the collaborative nature of learning. Social Constructivism was developed by post-revolutionary Soviet psychologist; Vygotsky. Vygotsky was a cognitivist, but rejected the assumption made by cognitivists such as Piaget and Perry that it was possible to separate learning from its social context. He argued that all cognitive functions originate in, and must therefore be explained as products of, social interactions and learning is not simply the assimilation and accommodation of new knowledge by learners; it is the process by which learners were integrated into a knowledge community.

Teaching strategies based upon cognitive dissonance and its resolution has been used as the basis for developing teaching strategies designed to teach for conceptual change. These teaching strategies are derived from a Piagetian constructivist view of learning; they involve creating situations where learners’ existing conceptions about particular phenomena or topic are made explicit and then directly challenged in order to create a state of cognitive conflict.

Cooperative Learning and Conceptual change Strategies related and rooted in both social and radical constructivism as they create and encourage social and pattern of interactions among students. Therefore it is against this premise that Cooperative Learning Approach is one of the appropriate and effective teaching strategies that guide the learners to attain goals that cannot be obtained working alone or competitively.

The use of active learning strategies, such as cooperative learning and Conceptual Change Strategy is growing at a remarkable speed. These learning strategies employ a variety of learning activities to improve students' understanding of a subject by using a structured approach which involves a series of steps, requiring students to create, analyze and apply concepts (Kagan, 1990). Based on the foregoing, the theoretical thrust of this study is derived from previous works of Dewey 1938; Piaget 1930, 1973, and Vygotsky 1978. The relevance of this investigation to such previous works is in the areas of cognition, logic reasoning, schema, problem-solving, groupwork, collaboration, memory inference and concept formation.

3. Literature Review

This study reviewed related studies; firstly, looking at the general definition of science as explained by different authors as cited by Ogunleye (2000) who views science as any discipline which can provide observable statement. Science can be defined as a cumulative and endless series of empirical observations, which result in the formulation of concepts and theories with both concepts and theories being subjected to modification in the light of further empirical observations. The review later went into specifics, paying particular attention to the teaching of biology in schools, examining why majority of the students considered biology to be the easiest science subject which they gave preference to, and in the long run, high percentage of the students failed at the school certificate level as indicated by (Salami, 2012).

One of the important aspects of this study is the review of literature on belief systems; hence various authors were cited in explaining societal belief systems and how these beliefs affect the learners over the years. It has been observed that both students and teachers of Biology in the secondary schools come to the Biology class with some misconceptions that are deeply rooted in different and contrasting religious beliefs and value systems as observed by (Delphonso, 2015). These misconceptions may – and indeed often – interfere with the teaching, learning and understanding of seemingly controversial Biology concepts in ways that undermine the learning and understanding of scientific concepts. Delphonso (2015) further opined that, as

long as both students and teachers hold these contrasting beliefs, effective teaching and learning of concepts in Biology will be difficult, and performance in such a subject is likely to be poor. Significant among these concepts are the concepts of Evolution and Genetics. Studies that have attempted to research the effect of these contrasting beliefs on students' learning have been scanty and their results are generally inconclusive and contradictory (Osborne, 1996). However, to achieve the desired quality development, quality education and Teacher Education must be repositioned to address some critical challenges otherwise; the dreamed development will be a mirage (Israel, 2018).

Literature reviewed was elaborately cited in one of the methods of this study – Conceptual Change, where authors experimented on conceptual change strategies and they all emphasized and recommended the strategy as one of the constructivist ideas which are based upon cognitive dissonance; its resolution has been used as the basis for developing teaching strategies to teach for conceptual change. These teaching strategies are derived from a Piagetian constructivist view of learning. They involve creating situations where learners' existing conceptions about particular phenomena or topic are made explicit and then directly challenged in order to create a state of cognitive conflict (Von Glaserfeld, 1988).

This study further reviewed reports and results of different studies on conceptual change strategy, and students' learning outcomes in science were extensively reported and documented; and reports indicated that the strategy enhanced the students' performance. Literature evidence concerning cooperative learning strategy has distinct advantage over the traditional methods (Slavin, 1987). Thus, the use of active learning strategies, such as cooperative learning and Conceptual Change Strategy, is growing at a remarkable rate. These learning strategies employ a variety of learning activities to improve students' understanding of a subject by using a structured approach which involves a series of steps that require students to create, analyze and apply concepts (Kagan, 1990).

4. Problem Identification

Over the years, it has been observed that both students and teachers of Biology in the secondary schools come to Biology class with some misconceptions that are deeply rooted in different and contrasting religious beliefs and value systems. These misconceptions may and indeed often interfere with the teaching, learning and understanding of these seemingly

controversial Biology concepts in ways that undermine the learning and understanding of scientific concepts.

The multicultural setting of the Nigerian society which encourages freedom of religion seems to have influenced different rivalry and contemporary religious belief systems and value systems and practices such that students develop a series of misconceptions about certain core concepts in Biology including evolution and genetics. Invariably such misconceptions are usually resistant to traditional method of teacher instruction. The combined impact of these factors is that students' acquisition of scientific concepts and the ability to build appropriate models for learning and understanding Biology concepts are distorted. This situation cuts across the whole world and it was corroborated by AfareezAbdRazak (2017) who opined that based on very significant differences in religion, language, dress and diet, have become highlighted more so than ever before. This awareness of conflict and resolution strategy should start early in an individual's life. Stephen (2014) describes some belief systems as "claptrap" which, according to him, "draws people in and holds them captive so they become willing slaves to victory." Accentuating his position, Stephen declares: "If you get sucked in, it can be extremely difficult to think your way clear again."

As long as both students and teachers hold these contrasting beliefs, effective teaching and learning of concepts in Biology will be difficult, and performance in such a subject is likely to be poor. It is reasonable therefore, to assume therefore that comparing a cooperative approach and conceptual change may be effective in modifying or changing students' original conceptions (misconceptions) in a way that can improve students' learning and performance in Biology.

5. Purpose of the Study

The purpose of this study is to investigate the effectiveness of cooperative learning and conceptual change strategies in improving learning outcomes of prospective biology teachers with different religious inclination.

Therefore, the **specific objectives** of this research are to:

- (i) determine the non-scientific pre-conceptions about evolution among Biology education students of Christian, Islamic and Traditional belief systems before they are taught (using Cooperative Learning Strategy (CLS), Conceptual Change Strategy (CCS));

- (ii) compare the effectiveness of CLS and CCS with the Teacher Expository Method (TEM) in promoting the performance of Biology education students with Christian, Islamic and Traditional belief systems;
- (iii) compare the attitudes of the students with Christian, Islamic and Traditional belief systems toward the learning of Biology (Evolution) when taught using CLS and CCS;
- (iv) Examine the effects of CLS and CCS on the retention ability in Evolution of Biology students with Christian, Islamic and Traditional belief systems.

6. Research Hypotheses

In the context of the above objectives the following research hypotheses will be tested:

- (i) There is no significant difference in the non-scientific preconceptions about evolution among Biology education students with Christian, Islamic and Traditional belief systems before they are taught (using Cooperative Learning Strategy (CLS), Conceptual Change Strategy (CCS) and Conventional Teacher Expository Method (TEM));
- (ii) There is no significant difference in the effect of CLS and CCS on the performance of Biology education students with Christian, Islamic and Traditional belief systems.
- (iii) There is no significant difference in the attitude of students toward concept of Evolution of Biology Education students with Christian, Islamic and Traditional belief system using CLS and those taught using CCS and;
- (iv) There is no significant difference in the retention ability of Biology students with Christian, Islamic and Traditional belief systems that were taught using CLS and those taught using CCS .

7. Scope of the study

This study examined the effectiveness of Cooperative Learning Strategy (CLS) and Conceptual Change Strategy (CCS) on the learning outcomes (performance, attitudes and retention) of Biology students in Colleges of Education with three religious belief systems (Christianity, Islam and Traditional Religion) on concept of evolution. The geographical coverage of the study was restricted to colleges of education located in Southwestern Nigeria.

8. Methodology

This study adopted the non-equivalent pre-test, post-test control group design. There were three groups in the study, two experimental groups and one control group.

The design for the study can be represented as:

Experimental Group I	O ₁	X ₁	O ₂	O ₃
Experimental Group II	O ₄	X ₂	O ₅	O ₆
Control Group	O ₇	X ₃	O ₈	O ₉

8.1 Population, Sample and Sampling Technique

The study population comprised Biology education students in colleges of education in South-western Nigeria. A total of 154 male and female part III Biology Education students in their intact classes in three randomly selected colleges of education in Southwestern Nigeria constitute the sample for the study. The schools were randomly assigned to experimental and the control groups.

8.2 Instrument

Two instruments were used in this study. The first instrument is the Achievement Test on Evolution (ATE), which was used for pretest, post- test and retention test and the second instrument is Biology Education and Attitudinal Questionnaire on Evolution (AQE) and was utilized to determine the attitude of the students towards Biology.

The instruments were pilot-tested on a sample of 25 students selected from a college of education in Ondo state using test-retest method. The scores on two administrations of the ATE (i.e. test re-test method) were subjected to correlation analysis using Pearson Product Moment Correlation Analysis (PPMCA). The reliability coefficient was 0.82 which was considered high enough as being reliable for the study. The reliability of the questionnaire was determined by Spearman Brown formula (Split- half method). The reliability coefficient was 0.78 which was considered reliable for the study.

8.3 Instructional Strategies used

The study utilized the following instructional strategies included;

- (a) Cooperative Learning Strategy (CLS);
- (b) Conceptual Change Strategy (CCS) and
- (c) Teacher Expository Method (TEM).

8.4 Data Collection

The procedure for collection of data was in three main phases and it lasted for eight weeks.

The phases were:

- ▶ Pre- test for the first one week
- ▶ Treatment for next six weeks
- ▶ Post-test for the last one week of the eight weeks.

Then a retention test was carried out two weeks after the post test.

8.5 Data Analysis

The data collected were analysed using Analysis of Variance (ANOVA), t-test and where significant difference occurred, the Scheffe Post-hoc test was used to determine the direction of the significance. All hypotheses were tested at $P < 0.05$ level of significance.

9. Results and Discussion

9.1 Hypothesis one

The hypothesis states that there is no significant difference in the non-scientific pre-conceptions about evolution among Biology education students of Christian, Islamic and Traditional religious belief systems before they were taught using Cooperative Learning strategies (CLS), Conceptual Change Strategy (CCS) and Teacher Expository Method (TEM).

The findings in this study indicated that there was no significant difference in the non-scientific pre-conceptions about evolution among Biology education students of Christian, Islamic and Traditional religious belief systems before they were taught using Cooperative Learning Strategies (CLS), Conceptual Change Strategy (CCS) and Teacher Expository Method (TEM). That is, the hypothesis is accepted. The findings is in accord with the cognitive psychologists with constructivists epistemological view, that students do not enter the class as a clean slate of mind, rather, they enter the class with a complex set of pre-conceptions (Ausubel,1968; Ausubel, Novak and Hanesian,1978; Brunner,1960; Nassbaum and Novak, 1986; Strike and Posner,1992; Oyedele, 1999).

9.2 Hypothesis two

There is no significant difference in the effectiveness of CLS, CCS and TEM in improving the performance of Biology education students in evolution before and after teaching. The result showed that a significant difference existed among the three groups with respect to their performance in Achievement Test on Evolution between the pre and post-test scores, therefore the hypothesis was rejected. It could be inferred from these findings that the treatment had tendency of enhancing performance more than the conventional method would do. This

agrees with the findings of Aluko (2008) which established better performance of students taught in cooperative learning settings compare to students using the conventional teaching methods. It also in accord with findings of Olatoye, Aderogba and Aanu (2011); Delphonso (2015) which stated that cooperative method significantly better than individualistic instruction techniques.

9.3 Hypothesis three

There is no significant difference in the attitude of students with the three religious belief systems toward evolution before and after being taught using CLS, CCS and TEM strategies. In order to test this hypothesis, the data obtained from the Attitudinal Questionnaire on Evolution (AQE) with Likert Scale was subjected to analysis of variance. Result showed that $F = 44.345$ which implies that there was a significant difference in the attitude of students towards evolution before and after their exposure to the teaching strategies. Therefore, the hypothesis was rejected. The result is in accord with Ajaja and Eravwoke (2010) that determine how the adoption of cooperative learning as an instructional strategy for teaching integrated science influences students' achievement and attitude towards learning science concepts.

9.4 Hypothesis Four

The hypothesis state that there is no significant difference in the retention ability in evolution of Biology students with the three religious belief systems exposed to CLS, CCS and TEM teaching strategies. Result was significant at $F = 5.22$, Therefore, the hypothesis is rejected, that is, there was a significant difference in the retention ability of the students after being exposed to the different teaching strategies. Result further showed that the CLS group has the highest mean score (63.00), followed by the CCS group (57.00) while the TEM has the least retention of the concept taught. This agrees with the findings of Muraya and Kimamao (2011) which established cooperative learning strategy (CLS) had better performance in terms of retention ability of students compare to students using conceptual change strategy (CCS) and teacher expository method (TEM). It also agrees with the findings of Saleh (2011) which established that students exhibited positive improvement in their studies when cooperative learning strategy was used in the classroom.

10. Conclusion

The study investigated the effectiveness of cooperative learning and conceptual change strategies in improving learning outcomes of college of education Biology students in South-western Nigeria and four hypotheses were generated and tested.

H₀₁ states that there was no significant difference in the non-scientific pre-conceptions about evolution among Biology education students of Christian, Islamic and Traditional religious belief systems before they were taught using Cooperative Learning strategies (CLS), Conceptual Change Strategy (CCS) and Teacher Expository Method (TEM). The outcome of the result indicated that there was no significant difference in the non-scientific pre-conceptions about evolution among Biology education students of Christian, Islamic and Traditional religious belief systems before they were taught using Cooperative Learning Strategies (CLS), Conceptual Change Strategy (CCS) and Teacher Expository Method (TEM). That is the hypothesis was accepted.

H₀₂ which states that there was no significant difference in the effectiveness of CLS, CCS and TEM in improving the performance of Biology education students in evolution before and after teaching. Result indicated that a significant difference existed among the three groups. The Scheffe post - hoc test for multiple comparisons was then carried out on the group means for the significant comparisons of the mean values of the three groups before and after exposure to the three strategies to know the direction of the difference. Result showed there was a significant difference between the CLS group pre-test and post-test. Also, there was a significant difference in the CCS group pre-test and post-test scores. Moreover, there was also a significant difference in the TEM pre-test and post-test scores. Therefore, the hypothesis was rejected.

H₀₃ which states that there is no significant difference in the attitude of students with the three religious belief systems toward evolution before and after being taught using CLS, CCS and TEM strategies. It was found out that there was a significant difference in the attitude of students towards evolution before and after their exposure to the teaching strategies. However, to determine where the significant difference occurred, a post- hoc analysis was carried out using Scheffe multiple comparison. Here result indicated that there was no significant difference in the attitude of the students with the difference belief systems in the control group before and after teaching using the conventional method but there was a significant difference in the attitude of students in the CLS and CCS groups before and after treatments.

H₀₄ which states that there was no significant difference in the retention ability of Biology students with the three religious belief systems exposed to CLS, CCS and TEM teaching strategies. Result revealed that there was a significant difference in the retention ability of the students after being exposed to the different teaching strategies. The Scheffe post-hoc test was then carried out on the group means for the significant comparison of the mean values of the

three groups. The Scheffe analysis showed that there was a significant difference among the three groups in their retention ability. But the CLS group has the highest retention ability followed by the CCS group.

In view of the above results, it implied that the Cooperative Learning Strategy produced the best result. Indicating that this strategy is the best suitable to produce a change in the belief systems of Biology Education Students on the concept of evolution.

11. Scope of Future Research

In other to determine the suitability of the forms of concept, cooperative learning strategy used in this study in teaching enhanced students achievement in effectively learning of Biology concepts, Biology education researchers may replicate and improve upon this study by selecting other Biology theories and concepts (like, reproduction, genetics, ecology, photosynthesis, etc.) in the Biology syllabus for secondary school.

There will be need to use this strategy in different topics and experiments since it will make a positive contribution to the academic performance and development of positive attitude towards the learning of Biology.

This study may also be conducted and improved upon by education researchers at other educational levels in the nation's education system (like, primary, secondary, and university institutions) in order to test cooperative learning strategy suitability in promoting meaningful learning and better students' achievement.

Finally, this study can be extended to other subject areas in order to ascertain the potency of cooperative learning strategy in other subject areas.

12. Research Limitation

This study was limited to only six Colleges of Education in south west of Nigeria due to financial and time constraints which prevented the researcher from reaching other places.

13. Recommendations

Based on the results, findings and discussions of this study, the following recommendations are made;

(i) Science educators should not abandon the search for instructional strategies that could totally eliminate students' pre-instructional misconceptions and prevent the establishment of post-

instructional misconception in Biology, in order to successfully accomplish the goals of Biology education.

(ii) As indicated from the findings in the study that the existence of post-instructional misconceptions related to evolution among students reflect the students' poor cognitive construction of their pre-instructional misconceptions in an attempt at conscious anchorage of new concepts of relevant concepts in their cognitive structure and a result hinders proper assimilation. This may be a result of the complexity of the new concept and the poor quality and many pre-conception, and this probably accounts for the students' application of two logically incompatible instructional misconceptions in this study. Hence, the biology teachers should learn and adopt to use it for teaching evolution and other similar complex biology theories and concepts.

(iii) It is also recommended that Biology teachers should be exposed to workshops and seminars where they will learn the use of cooperative teaching strategy in order to expose their students to this strategy in the classroom so as to promote social interaction, active students' participation, discovery learning, motivation learning by doing and learning by experience among students.

(iv) Federal and State ministries of education, education agencies and other stakeholders should formulate policy guidelines to guide the implementation process of the use of Cooperative learning strategy. In particular, the teachers would require training and reference materials on how to implement cooperative learning strategy which will make students good problem solvers.

(v) Teacher education programme in Nigerian tertiary institution should emphasize the use of cooperative method during science methodology classes so as to prepare teachers who can apply cooperative learning strategy to promote effective teaching and learning of Biology.

(vi) Textbook writers should shift emphasis from teachers' activities to students' activities that will promote learning by doing, discovery learning and further incorporate cooperative instructional strategy in Biology textbooks and including teachers' guide along with student copies.

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