Effect of Co-Operative/Collaborative Interaction in Problem-Based Learning (PBL) Context on Students' Achievement and Interest in Basic Science

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ABSTRACT

This study investigated the effects of co-operative/collaborative interaction in problem-based learning (PBL) context on students' achievement and interest in Basic Science. It was non-equivalent control group. To guide the study, two research questions and hypotheses were formulated. The area of the study was Ikot Ekpene Senatorial District of Akwa Ibom State. The sample consists of 304 JSII Basic Science students drawn from 4 schools in Ikot Ekpene Senatorial District of Akwa Ibom State. A total of 304 JSII Basic Science students were used for the study. Instruments for data collections were Basic Science Achievement Test and Basic Science Interest Inventory. The subjects in the study were exposed to pre-test treatment and post-test. Data collected were analyzed using a 2-way ANCOVA. Scheffe test was used to determine the level of difference between two means. The result from the analysis showed that there is a significant effect on student overall achievement and interest in Basic Science at 0.05 level of significance. The result showed that the students who use cooperative/ collaborative learning strategy performed better than those who studied Basic Science using the traditional base learning. Students who studies Basic Science with cooperative/ collaborative learning technique showed more interest than those who use traditional lecture-based learning strategy. Based on the findings it was recommended that Basic Science teachers should be encouraged to use cooperative/collaborative learning technique as an alternative and supplement to traditional lecture based learning.

KEYWORDS: Co-Operative/Collaborative Interaction, Problem-Based Learning (PBL) Context, Students' Achievement, Interest and Basic Science

Introduction

From time to time professional teachers' associations like Science Teachers Association of Nigeria (STAN) hold conferences, workshops and seminars for science teachers, so that the method of teaching Basic Science can improve and become interesting to the students. There is no gain saying the fact that technological development cannot be achieved without a good background in Basic Science. In the light of this, learners should be given a good background in the subject. This will determine the extent to which they will be interested in Sciences at senior secondary school and tertiary level of education. For Basic Science to be interesting and meaningful to the learners, they should be actively involved in sourcing information and generating solution to scientific problems, which they encounter in their daily life activities. One of the aims of education as cited by FRN (2008) is to inculcate in the child the spirit of enquiry, creativity through exploration of natural and local environment. The objectives of teaching Basic Science to Nigerian students are outlined as follows:

- Acquire basic knowledge and skills in science and technology;
- Apply scientific and technological knowledge and skills to meet contemporary societal needs;
- Take advantage of the numerous career opportunities provided by science and technology;
- Become prepared for further studies in science and technology;
- Avoid drug abuse and related vices;
- Be safety and security conscious.

Attainment of these laudable objectives demands that adequate strategies/techniques of communication and interaction with the learners be adopted by Basic Science teachers. In this regard, the Federal Ministry of Education (FME) (1985) recommended the use of guided inquiry method in teaching Basic Science. Teachers are encouraged to employ the student activity based and inquiry orientated mode of teaching so that the reason de-trio of Basic Science education can be achieved.

Regrettably most science teachers in a bid to cover their syllabus adopt traditional lecture based method in teaching Basic Science (Ali and Akubue 1987). This method is mainly teacher-centered and subject content driven (Liddle, 2000). It discourages initiative, curiosity and creativity in learners and does not offer learners the opportunity to interact effectively with their peers neither with their teachers nor with the learning materials such as textbooks and equipment. This has often resulted in students' loss of interest; reduced participation in class and poor learning achievement.

Focusing on this, Okebukola (1987), and Nzewi (1993) advocated the use of more effective method of teaching science. Problem based learning (PBL) no doubt can be one of such techniques. PBL is an instructional method that challenges students to learn by working cooperatively in a group to seek solution to life problems. These problems are used to engage

students' curiosity and initiative in learning the subject matter. PBL prepares students to think critically and analytically and to find and use appropriate learning resource (Dutch, 2001).

Learning within a Problem based learning curriculum hinges around examples of the ill-structure problems that typically occur in real life situation. Students are made to apply their problem solving skills, drawing on their existing knowledge. As the process unfolds, they identify new learning need and in turn explore them (Achuonye, 2004). The new knowledge gained is then brought back into the problem-solving process. The reiterative loop-systems, (in which the skills and knowledge acquired by students) are applied to the problem to evaluate the effectiveness of learning to reinforce learning (Barrows, 1886) provide students and teachers with considerable opportunity to monitor challenge and guide students' cognitive development.

Instruction interaction or classroom interaction occupies an important position in teaching and learning both in conventional education and distance education. Classroom instruction does not just occur by chance. It is properly planned and executed in order to facilitate learning. Instructional interaction can be categorized into three; Teacher-Learner Interaction (TLI); Leaner-Content Interaction (LCI), and Learner-Learner Interaction (LLI). In teacher-learner interaction, the teacher serves as an expert who plans the instruction to stimulate students' interest and motivate students. Thus TLI falls under TLBL (traditional lecture based learning).

The learner-content interaction offers the learner opportunity to study or work on a problem in a text read passage, solve problem in a computer experiment with materials and equipment. This can be likened to individualized learning. Learner-learner interaction is a situation where students react to each other's opinion and attitude during discussion, work in collaboration with students in small or large group on a given problem or project. The primary interest of cooperative/collaborative interaction is the improvement of motivation to learn attitude, incentive self-esteem, increased resources for problem-solving and an availability of scaffolding mechanism. In recent times things have changed, teachers are no longer seen as experts but as facilitators of knowledge. This is the era of information explosion, learning activity should be more of activity based, explorative, inquiry oriented as offered in PBL rather than passive as TBL for the development of a total person.

If science teachers adopt co-operative interaction in teaching Basic Science in a PBL environment, will they produce greater positive effect on the learners' environment, will they produce greater positive effect on the learners' achievement and interest towards the subject than when they are taught using TBL (conventional) context? It is against this background that this study is founded. Over the years many researchers focused on influence of instructional method and materials, teacher's behavior, reward pattern on the performance of student. Few studies have targeted interaction patterns especially learner-learner interaction which is an important component of the curriculum of PBL. The problem of this study therefore is, what is the effect of collaborative interaction on students' achievement and interest in Basic Science in problem-based-learning environment?

Purpose of the Study

The purpose of the study is to determine the effect of co-operative/collaborative interaction in problem-based learning (PBL) context on students' achievement and interest in basic science. Specifically, the objectives of the study are:

1. To compare the achievement scores of students who adopted cooperative/collaborative interaction strategy in studying Basic Science and those who use traditional lecture based method in studying Basic Science.
2. To compare the interest of those who studied Basic Science with cooperative/collaborative method and those who studied Basic Science with traditional lecture based method.

Research Questions

To guide the study, the following research questions were formulated:

1. What is the difference between the mean achievement score of students who adopted co-operative/collaborative interaction strategy in studying Basic Science and those who studied Basic Science under traditional lecture based environment?
2. What is the difference between the mean interest response score of students who studied Basic Science with co-operative/collaborative interaction strategy and those who use traditional lecture based (TBL) method in studying Basic Science?

Hypotheses

The following hypotheses guided the study:

1. There is no significant difference between the mean achievement score of students who adopted co-operative/collaborative interaction strategy in studying Basic Science and those who studied Basic Science under traditional lecture based environment at 0.05 levels of significance.
2. There is no significant difference between the mean interest response score of students who studied Basic Science with co-operative/collaborative interaction strategy and those who use traditional lecture based (TBL) method in studying Basic Science at 0.05 levels of significance.

Methodology

The study was carried out in Ikot Ekpene Senatorial District of Akwa Ibom State. The study is a quasi-experimental non-equivalent control group design involving two groups. Group A is the co-operative/collaborative interaction group (CCIG) symbolized as $0_1:X_1:0_2$. Group B is the control group – Traditional Lecture Based Learning Group (TBLG) symbolized as $0_1:-:0_2$ where 0_1A and 0_1A and 0_1B pretest, 0_2A, 0_2B are post-test X_1 – treatment level for (CCIG).

The population of the study consisted of all the junior secondary two (JSII) Basic Science students in Ikot Ekpene Senatorial District of Akwa Ibom State. The estimated population is about 3,200 students. (JSII) students were used because they should have been exposed to Basic Science right from primary schools and currently were not in the examination class.

Four schools (with three intact classes of JSII) Basic Science students were used for the study. A purposive and simple random sampling technique. The four schools are made up of two male schools and two female schools. Random sampling technique was used for assigning those classes to experimental and control groups. For each school selected two intact classes were used for the study. 304 JSII students were used for the study and their average age was 14 years.

Instrument for Data Collection

Two instruments namely, Basic Science Achievement Test (BSAT) and Basic Science Interest Inventory (BSII) were developed and used for the study. Two types of lesson plans were used, one for CCIG who studied under the PBL environment and the other under TLBL group.

Topics taught which include compound and mixture, separation of mixture, energy, work and force were derived from JSII Basic Science syllabus. The two groups were exposed to the same topics. BSAT comprised 30 items multiple choice achievement test. These were used on both the Pre-test and Post-test. Each correct score to the BSAT was scored 1 mark. BSII consists of 22 Likert type structured items and was used to determine the interest of the students in Basic Science based on the interaction pattern used.

Reliability of the instrument was determined using Kudder Richardson 21 (K-21) for BSAT and Crombach alpha (α) for BSII. In order to establish the reliability of the instruments 40 JSII Basic Science students (20 males and 20 females) from a different school that were not part of the sample were used. The data analyzed show a high reliability coefficient of 0.75 for BSAT and 0.90 for BSII.

Experimental Procedure

Prior to the actual exercise, the two intact classes were assigned to experimental group and control group using simple random sampling by balloting method. In the experimental group (co-operative/collaborative group) the students were stratified into heterogeneous groups of ten students each. Each group was made to choose a group leader (moderator) and a recorder (secretary) who was to put down the points which members agreed on as likely solution to the problem, the learning task given to each member of the group and also to write the summary of the findings as directed by the group. The class teacher acted as a facilitator; he or she gave dues on some material resources that may help each group which were derived from their immediate environment. BSAT was administered as a Pre-test to all the groups. (co-operative/collaborative and conventional group).

A problem and other guiding questions were read aloud by the group leader. Each member in the group was asked to discuss the problem, list out what he/she knows, what he/she does not know and what he/she needs to know; these formed the learning issues. After exhausting each member's opinion, the lesson was adjourned to the next day. Members were asked to research more and make some findings.

Next meeting, the facilitator encouraged students to re-examine the problems given to them in the previous class and integrate their new knowledge into the real life situation. This led to new learning issue which would make the student understand the PBL better. The group leader mandated the recorder to put down their likely answers based on the group's suggestion and submit to the teacher. In the TLB group, the interaction placebo was used and the TLB package was used for TLBG. After the treatment, a post-test was given to the two groups. Also BSII was administered to the groups. Out of the 304 questionnaire distributed, 302 were collected.

Method of Data Analysis

Two-way analysis of covariance (ANCOVA) was used in analyzing the data. Post-hoc multiple pair comparison test of 2 groups of learning method was conducted with scheffe test method to determine the significant difference in mean score. To determine the direction of difference of significance to mean score, the magnitude to mean score, the magnitude of the mean values was inspected.

Results

Hypothesis 1: There is no significant difference between the mean achievement score of students who adopted co-operative/collaborative interaction strategy in studying Basic Science and those who studied Basic Science under traditional lecture based environment at 0.05 levels of significance.

Table 1: Summary of Comparison of Students' Mean Cognitive Achievement Score in Basic Science between CCIG and TLBLG

Source	Sum of Squares	df	Mean Square	F-cal	Sig	F-Crit	Remarks
Interaction Learning Method CCIG and TLBLG	1489.895	2	744.948	96.80	.05 or .005	3	
Error	4791.787	449	10.672				

Table 2: Scheffe – Post hoc Test of Interaction Pattern Treatment Achievement Score

Interaction Learning Pattern	Mean	S.D.	Mean Difference	Std Error	Sig
CCIG	11.95	4.55			
TLBLG	7.95	3.57	3.9617	.45	0.007

The result in table 1 above shows a significant main effect for students' interaction pattern with respect to Basic Science F (2,449 = 69.80, P < .005). Pair wise comparison of mean in Table 2 showed a significant difference in students mean cognitive achievement score between CCIG and TLBLG (P< .005 Scheffe test).

The mean score for achievement test in Basic Science for CCIG (x=11.95 and S.D. = 4.55 is greater than the mean score of TLBLG. X = 7.95 and SD = 3.5. This implies that the co-operative/collaborative learning group performed better than the traditional lecture based learning group. Since F-Cal is greater than F-Crit, the null hypothesis is rejected.

Hypothesis 2: There is no significant difference between the mean interest response score of students who studied Basic Science with co-operative/collaborative interaction strategy and those who used traditional lecture based (TLB) method in studying Basic Science.

Table 3: Comparison of Students Mean Interest Response Score in Basic Science between Cooperative/Collaborative Interaction Group and Traditional Lecture Based Learning Group (TLBG)

Source	Sum of Squares	df	Mean Square	F-cal	Sig	f-Crit	Remark
Interaction Learning Method CCIG and TLBLG	16015.4881	2	8007.740	19.18	.001	3	*
Error	187433.08	449	417.446				

- **Significant of P <0.05**

Table 4: Scheffe – Post hoc Comparison Test of Interaction Pattern for Treatment Mean Interest Response Score

Interaction Learning Pattern	Mean	S.D.	Mean Difference	Std. Error	Sig
CCIG TLBLG	72.42 59.31	21.64 21.37	12.9765	2.3297	0.05

Table 3 shows a significant main effect for learning (interaction) methods with regards to students' interest in Basic Science F (2,449) 19.18, P< .005.

A pair wise comparison of mean in Table 4 show a significant difference in mean for interest in Basic Science between co-operative/collaborative interaction group with mean of 72.42 and standard deviation of 21.64 versus 59.31 with standard deviation of 21.37. The result shows that the co-operative/collaborative learning strategy increases students interest in Basic Science more than traditional lecture-based strategy. Hence P<0.05 scheffe test. Since F-Cal > F–Crit at 0.05 alpha level of significance, the null hypotheses is rejected.

Discussion of the Findings

From table 3, students who studied under co-operative/collaborative (CC) strategy performed better than the students who studied on TLBL strategy. The above finding is in line with the observation of Okebukola (1984) and William (2001), that cooperative group condition promotes a higher statistically significant (P<0.05) gain in students' achievement in biology and Basic Science.

In the present study, the superiority of the co-operative/collaborative learning strategy over the TLB strategy could be explained on the basis of group member's support and mutual involvement of the group members in learning. Cooperative interaction serves as a motivating force especially for the low ability learners in a CCIG.

Also the variation in the performance may be traced to the instruction strategy adopted. In PBL, problem was presented to the students before the knowledge based and the students embark on self-directed learning which enables them to discover new knowledge. It was easier for the students to retain that knowledge and be able to transfer their problem solving strategies to new problems.

From table 4, students who used CLI learning strategy showed more interest in learning Basic Science than the students who studied under TBL. The PBL students in CCIG are observed to be more satisfied with their curriculum than the students in TBL. Nworgu (1990), stressed that the nature and level of the activities in the class and the familiarity of the curriculum material are the two factors which can likely engender students' interest in science class. The instructional strategy which a learner finds pleasurable, appealing and involving is bound to be productive.

Implication of the Findings

The result of the study had some practical and educational implication. It has provided empirical evidence of the efficacy of co-operative/collaborative interaction (CCI) pattern in Basic Science in PBL context. There is a need for science teachers to adopt this innovation approach as alternative to conventional methods of teaching and learning in the classroom.

The idea that PBL works only in higher education has been disproved by the findings of the study. Hence CCIG is more effective than the TLBLG. Thus science teachers should not monopolize discussion in the class. The students should be allowed to collaborate and interact with their peers, engage in self-directed learning for improved performance and interest in Basic Science.

Cooperative/collaborative interaction pattern enhanced students' interest in Basic Science. This calls for teachers not to leave students on their own to learn without coaching them. It is important that when a learning task is given to students, teachers should suggest resources (like website, textbooks) that can be of help to them.

Conclusion

The study has shown that co-operative/collaborative interaction pattern have significant effect on the students' achievement and interest in Basic Science. Cooperative/collaborative learning strategy made more positive influence on student's cognitive achievement and interest than the traditional lecture based learning strategy.

Recommendations

Based on the above implications of the findings recommendations are made:

1. Cooperative/Collaborative Interaction learning technique should be incorporated in the science curriculum for pre-service teachers of Basic Science in order to popularize its use among teachers.

2. Basic Science teachers should be encouraged to use Cooperative/Collaborative technique as an alternative and a supplement to traditional based learning method.

3. Basic Science teachers should acquaint themselves with distinctive characteristics of CCI with a view of enhancing students' cognitive and effective outcomes of learning.

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