Effects of Implementation of Problem-Based Learning on Students 'Academic Achievement and Attitudes Towards Learning Chemistry

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Abstract - *This study aimed to determine the effects of problem-based learning on students' achievement and attitudes towards chemistry. Quantitative method was used. Data were obtained via pre/post-test, treatment-control groups and attitude questionnaire administration. The population was all NCE II chemistry students of Federal College of Education, Yola. Purposeful sampling technique was used in selecting a sample of fifty (50) students divided into experimental (EG) and control (CG) groups. Chemistry Achievement Test (CAT) and open-ended attitude scale questionnaire were used. The instruments were subjected to experts' opinion, their comments and observations were effected for validity. The experimental group was taught using problem-based learning approach for a period of 30 class hours and a traditional lecture method was employed on the control group. Questionnaire was administered on the experimental group. The data were analyzed using t-test and descriptive statistics. Findings revealed that, implementation of problem-based learning had positive effects on students achievement and attitudes towards learning chemistry. It also revealed that gender has no effect on students' achievement when expose to PBL. The researchers concluded that PBL enhances students 'achievement and attitude toward chemistry. They recommended for government and private sectors to encourage teachers adapt PBL approach, improve infrastructure, welfare of students and teachers through adequate funding.*

Keywords: Achievement; Attitude; Chemistry; Effects; Problem-based learning

1. INTRODUCTION

STUDENT'S ability to make connection with real life situations is important as these abilities are needed by their employers.The present science curricula being implemented are alwayscriticized of not producing students with enough experience and skills to solve problems and challenges of the imagined global trends [1].The basic aim of education is to enable individuals become effective problem solvers. It is therefore important for students to face real problems in their learning environment and proffer appropriate solutions to these problems [2][3]. The most convenient approach for achieving this in learning environments is the use of student-centered approach of learning such as the problem-based learning(PBL). Theglobal emerging trends in the pedagogical practices are approacheswhere learners take the responsibility of their learning and the opportunity to participate adequately in learning process as the teacher become a guide. These approaches helps students develop problem-solving skills and higher achievement in learning [4].PBL is rooted in Dewey's "learning by doing and experiencing" principle [5].

2.0 LITERATURE REVIEW

Lecture methodof teaching chemistry has been practiced for a long period in secondary and tertiary education whereteacher dominates the learning process through lectures and note taking. Students had to connect what they learn from the superficial abstract contents delivered by teachers in classes with the real worldlife problems in the society[6]. After more than two decadesof lecture method of teaching which fails to yield positive effects on students learning, constructivism theory of learning supporting student-centered learning process is getting more attention of stake holders in education. The theory emphasizes more on knowledge construction by the students not knowledge transmit ion from the teachers to students [7].

2.1 Implementation of Problem-Based Learning In Chemistry Education

PBL,learning process start with real worldproblems; It contents and practices must be attractive to students. The students must be encouraged to have adequate time to collect information and set strategiesof solvingproblems [8].PBL enablestudents see events across disciplines.Although teachers have difficulty to changeteaching styles and it is time consuming [9]10]. PBLengaged students to learn through presentations and interactions in groups and places more responsibility of comprehension on them; thisimproved theirlearning and development of problem solving skills,thus translate into higher studentsachievements[11][12]. PBL is very effective in enhancing studentachievement in chemistry and it is gender friendly as both male and female showed equally improved achievement[13].PBL has effect on student achievement." thereforeit is more effective than lecture

method.PBL strategies are connected to students'future careers, it encouragesthem to search for solutions to theproblems inclass rooms andeveryday lives.This enables them understandthe connection between science classes and situation in the society, hence they develop interested, positive attitude towards learning and achievemore [14].

2.2 Objectives of the Study

Despites the implementation of PBL in many parts of the world, it is still however a new experience in Nigerian science curriculum. The efficiency of PBL need to be explored considering its limitations to enables students acquires problem solving skills and improves learning but not to be afraid of problems. The objective of thisresearch is to determine whether the implementation ofPBLin tertiary educationbrings about significant differences in students' achievementand their attitudes towardslearning chemistry. Also if there is difference in the achievement due to gender.To achieve thisobjective,the following nullhypotheses weretested:

Ho_1: There is no significant difference in the academic achievement of students taughtchemistry using PBL and those taught using lecture method of teaching.

Ho_2: There is no significant difference in the academic achievement of boys and girls when exposed to PBL.

Ho_3: There is no significant difference in the attitude towards chemistry by students taught using PBL and those taught using lecture method.

3.0 METHODOLOGY

This research used quantitative approach and quasi-experimental& control groups design. The population is all NCE II chemistry students in F.C.E. Yola, Nigeria. Purposeful sampling technique was used in selecting a sample of fifty (50) students divided into experimental (EG) and control (CG) groups. Data was collected throughChemistry Achievement Test (CAT)containing (30) structured multiple choice items and 12 itemed attitude questionnaire. The instruments were handed to experts forvalidity assessment.The two groups were pretested for their equivalence in ability using (CAT). The (EG was then taught chemistry using PBL forthirty (30) class hours while the (CG) was taught using the lecture method for the same period.A post-test was conducted to both groups using (CAT) to determine the effects of the PBL on students' achievement. An attitude questionnaire was also administered to the (EG) to determine their attitude towards the PBL. The data was analyzed using t-testand descriptive statistics.

4.0 RESULTS AND DISCUSSION

4.1 Null Hypothesis Ho_1:

There is no significant difference in the academic achievement of students taught using PBL approach and those taught using lecture method.To test this hypothesis, the post-test scores of the (EG) and (CG) were analyzed using t-test statistics. The result of the t-test analysis is shown in Table 1.

Table 1: Result of t-test Analysis of Post-test Scores of (EG) and (CG)

Group	N	Mean	df	t-cal.	t-critical $\alpha = 0.05$
Exp'tal	25	70.80	24	12.35	2.06
Control	25	58.23			

From Table 1 the t-calculated of 12.35 is greater than the critical t-value of 2.06 at 0.05 level of significance and degree of freedom of 24. This mean, there is significant difference in achievement of the (EG) and the (CG) in (CAT). This shows that the students in the (EG) achieved higher than those in the (CG) in (CAT). The mean score (70.80) of the (EG) is also higher than the mean score (58.23) of the (CG) as shown in Table 2. This indicates that the (EG) exposed to PBL approach performs better than the (CG) exposed to lecture method.Based on the result, the null hypothesis (Ho_1) is therefore rejected. The PBL approach is therefore more effective in improving student's achievement than the lecture method. This finding is in line with the report that collaborative learning activities of PBL generates high frequency of students' interactions, development of problem solving skills, improved learning, this translates to higher students achievements[8].The finding is also supported by [11] who reported that PBL is very effective in increasing students' achievement in chemistry than the Lecture method. It is also in support of the report that students taught using PBLapproach are more successful than those taught with traditional lecture methods [3].

4.2 Null hypothesis 2:Ho_2:

There is no significant difference in academic achievement of boys and girls when exposed to PBL approach of chemistry teaching. To test the hypothesis, the post-test scores of the (EG) was also analysed using t-test statistics. The result of the t-test analysis is shown in Table 2

Table 2: Result of the t-test Analysis of Post-test Means Scores for the (EG)

Gender	N	df	t-cal	t-critical $\alpha = 0.05$
Boys	10	9	0.94	2.26
Girls	10			

From Table 2, the calculated t-value of 0.94 is less than the critical t-value of 2.26 at 0.05 level of significance and degree of freedom of 9. These results indicate that there is no significant difference in the achievement of boys and girls when taught chemistry using PBL. This implies that boys and girls perform equally well when exposed to PBL approach. Therefore the null hypothesis (Ho_2) is upheld.

The finding is supported by research report that PBL is gender friendly as both male and female showed equally improved achievement when taught chemistry [11].

4.3 Null hypothesis (Ho_3):

There is no significant difference in the attitude towards chemistry by students taught using PBL and those taught using lecture method. To test this null hypothesis 3, thequestionnaireis analyses using descriptive statistics as shown in Table 3.

4.3: Table 3: Analysis of responses of (EG) attitudes towards chemistry

Questionnaire item no.	1	2	3	4	5	Mean	Std
	Frequencies						
1.	0	2	6	12	10	4.00	0.91
2.	0	0	4	14	12	4.26	0.69
3.	0	2	6	10	12	4.06	0.94
4.	0	6	4	10	10	3.80	1.10
5.	0	2	6	12	10	4.00	0.91
6.	0	4	6	10	12	3.86	1.04
7.	0	4	2	14	10	4.00	0.98
8.	2	0	4	12	12	4.06	1.08
9.	4	0	6	10	10	3.73	1.31
10.	0	2	6	14	8	3.93	0.86
11.	0	4	2	12	12	4.06	1.01
12	0	4	6	10	12	3.86	1.04

Note: [1= strongly disagree, 2= Disagree, 3= Neutral, 4= Agree, 5= strongly agree & Std= Standard deviation.

Table 3 shows that the students have positive attitudes and high level of satisfaction toward learning chemistry because of their PBL experiences. It is also clear from the table,that all the mean scores of (EG) responses are greater than 3.0 and most of the standard deviations (Std) are approximately 1.Therefore there is a significant difference in the attitudes towards chemistry of (EG) and (CG), hence the null hypothesis (Ho_3) was rejected. This finding is supported by the research reports that students exposed to PBL experiences shows positive attitudes and good satisfaction towards learning chemistry [2]. The collaborative and self-directed learning activities of the PBL develop students'higher-order thinking skills and positive attitudes towards learning science [14].

5.0 CONCLUSION

Based on the findings of this study, the researchers concluded that the implementation of PBLimproved both male and female students' achievement and attitude toward learning chemistry.

6.0 RECOMMENDATIONS

Based on the conclusions, theresearchers recommended that stake holders in education should discourage lecture method and encourage students-centered approach (PBL) that is more effective to enhance students' achievement. They should provide adequate funds for infrastructure and the welfare of staff and students.

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