Journal of Education and Human Development
September 2015, Vol. 4, No. 3, pp. 169-180
ISSN: 2334-296X (Print), 2334-2978 (Online)

Published by American Research Institute for Policy Development
DOI: 10.15640/jehd.v4n3a18
URL: http://dx.doi.org/10.15640/jehd.v4n3a18

Relative Effectiveness of Learning-Cycle Model and Inquiry-Teaching Approaches in Improving Students' Learning Outcomes in Physics

AKINWUMI Mojeed Olaoluwa[1] & BELLO Theodora Olufunke[2](Ph.D.)

Abstract

The study compared the effectiveness of Learning-Cycle Approach (LCA) and Inquiry -Teaching Approach (ITA) in improving students' academic performance in Physics. It also determined the effectiveness of the instructional strategies in enhancing retention of Physics concepts; and established their effectiveness in improving students' attitude to Physics. These were with a view to improving students learning outcomes in Physics. The study adopted the non-equivalent pre-test, post-test control group design. The study sample consisted of 103 Senior Secondary School two (SSSII) students in intact Physics classes selected from Gbonyin Local Government Area in Ekiti State, Nigeria. The instruments used for data collection were "Physics Achievement and Retention Test" (PART) and "Physics Attitude Questionnaire" (PAQ). The reliability coefficients of 0.86 and 0.75 were obtained for PART and PAQ respectively. Data collected were analyzed using descriptive statistics, Analysis of Variance (ANOVA) and the Scheffe's Post Hoc analysis. The results showed that students in the experimental groups (LCA and ITA) gained higher scores than those in the control group, with the LCA being the most effective. Also, the result showed that LCA and ITA enhance students' retention of Physics concepts with the retention test mean score of students taught using LCA being the greatest. Finally, it was revealed that LCA and ITA showed relative effectiveness in improving the students' attitude to Physics with LCA as the most effective. The study concluded that the LCA produce significantly better performance and retention of Physics by students than ITA and TEA, this is an indication that LCA is an effective mode of instruction for Physics students. The study recommends that teacher education programmes should emphasize LCA and ITA when in Physics class; also teachers should be provided adequate training to enable them use LCA and ITA in Physics classroom so that learners would be guided to learn meaningfully and would be assisted to develop positive attitude towards Physics.

Keywords: Learning Cycle, Inquiry Learning, Attitude, Retention, Physics.

1. Introduction

Science has been regarded as the bedrock of modern day technological breakthrough (Oladejo et al, 2011). Countries of the world, especially the developing ones like Nigeria, are striving hard to develop technologically and scientifically. Since the world is turning scientific and proper functioning of life depends greatly on science. Science has become an integral part of the world's culture; even the remotest villages on earth are not devoid of the impact of science. In all areas of human endeavour, the individual comes in contact with various forms of scientific equipment and contraptions that demands basic scientific skills and knowledge for proper handling and manipulation, equipment in the home that cannot be operated without a fair degree of science training.

[1] [1]Department of Science and Technology Education, Obafemi Awolowo University, Ile-Ife, Nigeria
[2] Institute of Education, Obafemi Awolowo University, Ile-Ife, Nigeria, E-mail: bledora@yahoo.co.uk

Ogunniyi et. al. (2005) recognized the fact that, there are some commonly used gadgets or equipment that would constitute a real threat to life if the user operating them is not scientifically literate. This clearly shows that human being's existence is largely governed by science. Many studies revealed that, the distinction between the developed and a developing country is due to their degree of scientific development. It was also observed that a modern man today is the one that is living in the industrialized age. An immediate consequence of this is that most of the jobs being created in the society are tied to science. Ogunleye (2002) defined Science as dynamic human activity concerned with understanding the working of our world. This understanding helps man to know more about the nature of the universe so as to be able to fit into today's world. The emergence of a highly competitive and integrated economy, rapid scientific and technological innovations, and an explosion of knowledge will continue to have a great impact on our lives. In order to meet the challenges posed by these changes. Physics, like other science subjects, provides a platform for developing scientific literacy and for building up essential scientific knowledge and skills for life-long training and knowledge acquisition in science and technology.

Physics is one of the most fundamental natural sciences that involve the study of universal laws, the behaviours and relationships among a wide range of physical phenomena. Through the learning of Physics, students will acquire conceptual and procedural knowledge relevant to their day to day activities. In addition to the relevance and intrinsic beauty of Physics, its study also helps students to develop an understanding of its practical application to wide variety of fields associated with scientific and technological development.

Despite the application of Physics to solving societal problems, it traditionally attracts fewer students than Chemistry and Biology. The West African Examination Council (WAEC) Chief Examiners' Report 2013 and subsequent years revealed that performance of Nigerian students in Physics is generally not encouraging. Many reasons have been advanced for this shortfall which includes attitude of students towards the subject, the nature of the subject, inadequate instructional materials in the school, and the teaching methods used by the Physics teachers. Craker (2006) in a study on student's attitude to science subjects showed that, Physics is considered the most difficult and problematic in the realm of science, which makes the subject less attractive to many students.

The poor performance of students in science subjects (Physics inclusive) has become a source of concern to all. In the light of this, science educators need to seek suitable ways of tackling the current mass failure if they are to halt the drift of students to humanities and business related subjects (Agboola & Oloyede, 2007).

Olorundare (2011) noted that the major reason alluded to the persistence of poor performance of students in science subjects at school certificate level is that, most science teachers in secondary schools in Nigeria probably do not generally vary the teaching strategies they use. Consequently, they are not able to cope with some specific difficulties associated with the teaching and learning of science by both the teacher and the students respectively. He further explained that, classroom teachers could be knowledgeable in science content but not in the pedagogical aspect. Nwagbo (2011) quoting research reports noted that teachers shy away from the more effective activity oriented teaching methods in preference for methods that are easy and most times inadequate and inappropriate. Since the quality of any educational programme is the function of those who teach it. Jacinta & Nkasiobi (2011) opined that teachers are expected to be intellectually and professionally competent as well as dynamic enough to adapt to the scientific growth and development by discharging their duties to a much satisfying level. The study further emphasized that even a good curriculum in a well-stocked classroom and laboratory would still not give the desired result in the hands of an incompetent teacher or a teacher using poor teaching methods.

Many investigations have revealed that secondary school students are exhibiting dwindling interest in Physics (Esiodu, 2005; Oladejo et al., 2011). Also, Bello (2012) posited that, availability and utilization of science laboratory equipment are critical variables in determining the quality of output from senior secondary school physics. This means, most of the problems faced by students in Physics classrooms lies on the quality of teaching environment and the way teachers presents the content to the students. In line with this development, Oladejo et al. (2011) explained that poor academic achievement in Physics could be attributed to many factors among which teachers' strategy was considered as an important factor. This may mean for the effective implementation of Physics curriculum content, the teacher should be ready to take its place in the scheme of things.

The curriculum of Physics according to Abubakar (2012) is to make the study of Physics more exciting and to introduce the learning of the subject in real life situation. The adoption of diverse learning contexts, learning and teaching strategies, and assessment practices is intended to appeal to students of all abilities and aspirations, and to stimulate their interest and motivation for learning among them.

Agboola & Oloyede (2007) opined that, one of the objectives of science education is to develop students' interest in science and technology. Research reports such as Schwab, (1962); John & Muhammed, (2004); Hasret & Necati, (2006); Oladejo et al. (2011) showed that in most Physics classrooms, the lecture methods were adopted. Various teaching methods have been suggested to reduce this menace, among which are (Liewellyn, 2007; Susanne, 2011; Bello, 2011). Despite the development of these lofty instructional strategies in theory, one would wonder why Nigeria Physics teachers are convenient with the traditional lecture method regardless of its attendant effect on level of achievement of students in Physics. The transmission is said to be effective but the reception is negligible. The teachers' methods of teaching may go a long way in enhancing effective learning by the students. Studies have advocated for the 21st century approaches to science teaching in Nigeria. These approaches include inquiry, collaborative and discovery instructional strategies among others.

In effect, the need therefore arises for educators to determine which of the available teaching approaches can actively involve students in exploration of the content, a strategy that is student centered and can actively foster the required interaction for effective internalization and retention of Physics concepts. While the approach is meant to be highly student-focused, the extent of teacher-directed learning can vary depending on the level of the students in the class and their understanding of the teaching-learning process (Jill, 2007). Educators need to help students form connections between classroom science and the student experiences of living in the society (Burkel, 2007). One strategy for helping students make connections between classroom science and personal experience is learning cycle instructional approach. According to Liewellyn (2007), the learning cycle and inquiry teaching approach can help move from concrete experience, to the development of understanding the application of scientific principles. It is on this note that this study aims at investigating suitable instructional strategies that suit the modern day scientific teaching and learning towards enhancing performance, retention and change in student attitude towards Physics.

1.1 Objectives of the Study

The study investigates the effectiveness of learning cycle approach (LCA) and inquiry teaching approach (ITA) in improving students learning outcomes in Physics with the aim of determining which of them will be more effective. Therefore the specific objectives of the study are to:

i. compare the effectiveness of Learning-Cycle Approach (LCA), Inquiry-Teaching Approach (ITA) and Teacher Expository Approach (TEA) in improving students' academic performance in Physics;
ii. determine the comparative effectiveness of the instructional strategies in enhancing retention of Physics concepts; and
iii. Assess the relative effectiveness of the learning strategies in improving students' attitude to Physics.

1.2 Research Hypotheses

The following research hypotheses were generated to guide the study:

(i) There is no significant difference between the academic performance of students exposed to LCA, ITA and TEA in physics.
(ii) There is no significant difference in the retention ability of students exposed to LCA, ITA and TEA in Physics.
(iii) There is no significant difference in the attitude of students exposed to LCA, ITA and TEA in Physics.

1. *Methodology*

2.1 Research Design

The study employed the used of non-equivalent pre-test, post-test, control group experimental design as described by Cambell & Stanlly (1966). The pre-test post-test imply that tests are administered to the sample for the study before and after the intervention. The pre-test purposely helps in assessing the differences between the

experimental and the control groups and also ascertain a baseline for the effect of the treatment. The design for the study is as follows:

Pre-test	Treatment	Post-test	Retention test
O_1	X_a	O_2	O_3
O_4	X_b	O_5	O_6
O_7	X_c	O_8	O_9

O_1, O_4 and O_7 represent the pre-test score for experimental groups A and B and the control group C respectively, while O_2, O_5 and O_8 are the respective post-test scores and O_3, O_6 and O_8 are retention test.

X_a represent Treatment 1 - Learning Cycle Approach (LCA)
X_b represent Treatment 2 - Inquiry Teaching Approach (ITA)
X_c represent Treatment 3 - Teacher Expository Approach (TEA) which is the control group

This is considered appropriate because of its ability to control extraneous factors that may pose a threat to internal and external validity of the experiment. It also allows for easy use of intact classroom as it does not cause disorganization of the school setting, that most school administrators usually want to guide against.

2.2 Population, Sample and Sampling Technique

The population for the study comprised all the Secondary School II (SSII) Physics students in Gbonyin Local Government Area of Ekiti State. The choice of SS II students is considered appropriate because it is believed that they must have been exposed to some basic Physics concepts and acquired some manipulative skills.

The study sample consisted of 103 SSS II students in intact Physics classes in the Local Government Area (LGA). Three schools were randomly selected from the LGA. One arm of SSS II students was selected in each of the three schools using the simple random sampling technique. Each arm of students was randomly assigned to experimental groups A, and B, and the control group C.

2.3 Research Instruments

Two research instruments titled Physics Achievement and Retention Test (PART) and Physics Attitude Questionnaire (PAQ) were used for the purpose of data collection. The PART consist of 20 multiple choice objective test items drawn from past West Africa Examination Council (WAEC) questions. The PART serves as pre-test to ascertain equivalent ability of the groups, post-test to determine the effect of the treatment on their academic performance, and the retention test was administered two weeks after the post-test to determine the extent of their Physics concept retention.

The PAQ consisted of 20 carefully structured items that sought for information on their attitude towards Physics. It is a Likert-type ratio scale which was rated on 5-point scale with 4 – Strongly Agree (SA), 3 – Agree (A). 2 – Disagree (D) while 1 and 0 go for Strongly Disagree (SD) and Undecided (U) respectively.

2.4. *Validity and Reliability of Research Instruments*

The instruments were validated by giving them to three experts in educational research for vetting. Thereafter the items were modified based on the suggestions raised by these experts. Field testing was carried out by administering the instruments to 32 students from intact Physics class outside the selected schools. The test was administered once. The responses were split into two halves for the purpose of scoring. The Split Half reliability test was carried out and the reliability coefficients were calculated to be 0.86 and 0.75 for PART and PAQ respectively.

2.5 *Procedure for Data Collection*

There were four stages involved in this research: the administration of pre-test, the intervention stage, the post-test and the retention test stages. In the pre-test stage, the PART and the PAQ were administered to the two experimental groups A, B and the control group C to ascertain equivalent ability and attitude at the entry level of the

experiment. In the intervention stage, students in group A were taught using the Learning-Cycle Approach (LCA), while students in group B were taught using the Inquiry-Teaching Approach (ITA) and students in group C which was the control group were taught using the Teacher Expository Approach (TEA). In the LCA group students under the guidance of the teacher were made to engage, explore, explain, elaborate and evaluate concepts (5E Learning-Cycle).

The first phase of the learning cycle, the engagement phase, and the teacher assessed the learners' prior knowledge and introduced short activities to promote curiosity, an activity that exposes misconceptions through questioning. The second phase, exploration phase, students were given opportunities to work together without direct instruction from the teacher. Conceptual changes were facilitated and misconceptions cleared. The third phase, the explanation phase, students were made to explain concepts in their own language. They were made to listen to themselves and gave explanations on what they discovered at the exploration phase. The teacher gave explanations which were expected to provide deeper understanding. The fourth phase, the elaboration phase, students applied concepts discovered in new but similar situations. The fifth phase, the evaluation phase, the students assessed their understanding and abilities. The teacher also assessed the students by asking open ended questions that can encourage future investigations.

The ITA group was taught by providing discrepant situations that made the students formulated and tested hypotheses through hand-on experiences which were driven by questioning technique, and took the form of Concept Introduction (CI), Concept Formation (CF) and Concept Application (CA). During the CI stage, students were given solid materials to work with and kept the record of findings. In the CF stage, questions were raised on the findings in the CI stage. The teacher directed the students' hands on experiences towards the concept to be developed. In the CA stage, students combined their findings and related them mathematically and also applied their results in new situations. The students wrote reports of their findings. The teacher finally evaluated and allowed students to ask questions. In the TEA group, the students received direct instructions from the teacher in terms of verbal expositions without hands-on activities.

The interventions were carried out by the researcher who taught concept of forces, equilibrium of forces, centre of gravity and stability. The treatment in all the groups covered two periods per week for a period of four weeks. The PART and PAQ were administered to the three groups as post-test to determine the effect of the intervention on their performance and attitude. The last stage was the administration of the retention test which came up exactly two weeks after the post-test using PART and PAQ which were re-structured before administration.

2.6 Method of Data Analysis

The pre-test, post-test and the retention test scores from the instruments administered to the students in the experimental and control groups were coded and input to the computer using Statistical Package for the Social Sciences (SPSS) for analysis. The null-hypotheses generated were tested using descriptive statistics, Analysis of Variance (ANOVA) and the Scheffe's Post Hoc analysis.

2. *Results*

3.1 *Analysis of pre-test scores*

To determine the possible difference in background knowledge of students' in Physics, the pre-test scores were subjected to One-way Analysis of Variance (ANOVA) and the results are presented in table 1.

Table 1: One-way ANOVA of the Pre-test Scores of Students

	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	7.166	2	3.583	0.978	0.380
Within Groups	366.349	100	3.663		
Total	373.515	102			

$p>0.05$

The results from table 1 shows that the F = 0.978, at P = 0.05 indicated that there is no significant difference between the means of the two experimental and the control groups. The between group mean square is not significantly greater than within group mean square. This result shows that there were no significant differences in the pre-test scores across the three groups. It is therefore assumed that the three groups started with same equivalent mean scores. This shows that the students from the groups enter the experiment at the same entry level and background knowledge.

3.2 *Hypotheses Testing*

Hypothesis One: There is no significant difference between the academic performance of students exposed to LCA, ITA and TEA in Physics.

In testing this hypothesis, the pre-test and post-test scores of the LCA, ITA and TEA groups were compared and analyzed using one-way analysis of variance (ANOVA) at 0.05 level of significance and Scheffe's Post Hoc test. The results are presented in tables 2a and 2b.

Table 2a: One-way ANOVA for the Performance of Students taught using LCA, ITA and TEA.

	Sum of Squares	d f	Mean Square	F	Sig.
Between Groups	1161.000	5	232.200	51.408	.000
Within Groups	903.354	200	4.517		
Total	2064.354	205			

P>0.05

Table 2a shows the ANOVA analysis of the students' pre-test and post-test scores in the experimental and control group. The F = 51.408 at 0.05 level of significance clearly indicates significant effect of the intervention/treatment on the students.

A Scheffe's Post Hoc test for data snooping was carried out on the group means to detect the most significantly effective among the three means. The results are presented as follows in table 2b.

Table 2b: Scheffes' Pair-wise Multiple Comparison of Pre-test and Post-test

(I) APPROACHES	(J) APPROACHES	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
Pre-test LCA	Post-test LCA	-6.01613*	.53559	.000	-7.8162	-4.2160
	Pre-test ITA	.36486	.51305	.992	-1.3595	2.0892
	Post-test ITA	-3.15789*	.50991	.000	-4.8717	-1.4441
	Pre-test TEA	.64706	.52345	.909	-1.1122	2.4063
	Post-test TEA	-.02941	.52345	1.000	-1.7887	1.7299
Post-test LCA	Pre-test LCA	6.01613*	.53559	.000	4.2160	7.8162
	Pre-test ITA	6.38099*	.51747	.000	4.6418	8.1202
	Post-test ITA	2.85823*	.51436	.000	1.1295	4.5870
	Pre-test TEA	6.66319*	.52778	.000	4.8893	8.4370
	Post-test TEA	5.98672*	.52778	.000	4.2129	7.7606
Pre-test ITA	Pre-test LCA	-.36486	.51305	.992	-2.0892	1.3595
	Post-test LCA	-6.38099*	.51747	.000	-8.1202	-4.6418
	Post-test ITA	-3.52276*	.49085	.000	-5.1725	-1.8730
	Pre-test TEA	.28219	.50490	.997	-1.4148	1.9791
	Post-test TEA	-.39428	.50490	.987	-2.0912	1.3027
Post-test ITA	Pre-test LCA	3.15789*	.50991	.000	1.4441	4.8717
	Post-test LCA	-2.85823*	.51436	.000	-4.5870	-1.1295
	Pre-test ITA	3.52276*	.49085	.000	1.8730	5.1725
	Pre-test TEA	3.80495*	.50171	.000	2.1187	5.4912
	Post-test TEA	3.12848*	.50171	.000	1.4423	4.8147

Pre-test TEA	Pre-test LCA	-.64706	.52345	.909	-2.4063	1.1122
	Post-test LCA	-6.66319*	.52778	.000	-8.4370	-4.8893
	Pre-test ITA	-.28219	.50490	.997	-1.9791	1.4148
	Post-test ITA	-3.80495*	.50171	.000	-5.4912	-2.1187
	Post-test TEA	-.67647	.51545	.885	-2.4089	1.0560
Post-test TEA	Pre-test LCA	.02941	.52345	1.000	-1.7299	1.7887
	Post-test LCA	-5.98672*	.52778	.000	-7.7606	-4.2129
	Pre-test ITA	.39428	.50490	.987	-1.3027	2.0912
	Post-test ITA	-3.12848*	.50171	.000	-4.8147	-1.4423
	Pre-test TEA	.67647	.51545	.885	-1.0560	2.4089

The mean difference is significant at P>0.05 levels. The results from table 2b shows that, the mean score for post-test of the groups are significantly greater than respective mean scores of pre-test. This indicates that all the approaches have effects on performance of the students in Physics. Specifically, the mean difference of the post-test and pre-test scores of LCA (6.01613) was found to be significantly higher than that of ITA (3.52276) and that of TEA (0.67647). This point to the fact that LCA has the highest effectiveness in enhancing students' performance, followed by ITA and TEA as the least effective. Based on these results, the null hypothesis is hereby rejected and the alternative hypothesis which states that there is significant difference between the academic performance of students exposed to LCA, ITA and TEA in Physics is upheld.

Hypothesis Two: There is no significant difference in the retention ability of students exposed to LCA, ITA and TEA in Physics.

To test this hypothesis, the retention tests as well as the gain scores of the three groups were compared using the descriptive analysis and the ANOVA. The results are presented in tables 3a and 3b.

Table 3a: Descriptive statistical analysis of Retention Test Scores and Gain Scores of Physics taught using LCA, ITA and TEA

					95% Confidence Interval for Mean			
	N	**Mean**	**Std. Deviation**	**Std. Error**	**Lower Bound**	**Upper Bound**	Minimum	Maximum
LCA	31	14.2188	2.36554	.41817	13.3659	15.0716	10.00	19.00
ITA	38	11.6216	2.05955	.33859	10.9349	12.3083	8.00	17.00
TEA	34	7.1471	1.98681	.34074	6.4538	7.8403	3.00	11.00
Total	103	10.9515	3.57929	.35268	10.2519	11.6510	3.00	19.00

The table 3a shows the mean scores of the retention test which indicates that the LCA (14.2188) is greater than ITA (11.6216) and TEA with (7.1471). This clearly depict that the students taught using LCA retains the Physics concepts better than the students taught using the ITA and the students taught using TEA taking the least.

Table 3b: One-way ANOVA analysis of Retention Test Mean Scores of Students taught using LCA, ITA and TEA

	Sum of Squares	**Df**	**Mean Square**	**F**	**Sig.**
Between Groups	850.321	2	425.161	93.148	.000
Within Groups	456.436	100	4.564		
Total	1306.757	102			

p>0.05

The results from table 3b indicates that, at p=0.05, F = 93.142, depicts that significant difference exists in retention of Physics concepts among the students taught using LCA, ITA and TEA. The hypothesis stating that, there is no significant difference in the retention of students taught using LCA, ITA and TEA in Physics is hereby rejected.

Hypothesis Three: There is no significant difference in the attitude of students exposed to LCA, ITA and TEA in Physics.

In testing this hypothesis, the pre-test and post-test mean score of students from the Physics Attitude Questionnaire (PAQ) in the three groups were compared using the one-way ANOVA and the Scheffe's Post Hoc test. The results are presented in tables 4a, 4b and 4c.

Table 4a: Descriptive Statistics of Students' Pre-test and Post-test Attitudinal Test

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
Pre-test LCA	31	49.6250	7.37367	1.30349	46.9665	52.2835	34.00	64.00
Post-test LCA	31	66.6774	5.60587	1.00684	64.6212	68.7337	54.00	76.00
Pre-test ITA	38	55.1351	7.21943	1.18687	52.7281	57.5422	40.00	68.00
Post-test ITA	38	60.5526	6.29756	1.02160	58.4827	62.6226	50.00	72.00
Pre-test TEA	34	59.5294	6.52842	1.11962	57.2515	61.8073	47.00	72.00
Post-test TEA	34	58.9118	6.34545	1.08824	56.6977	61.1258	45.00	72.00
Total	206	58.3641	8.23961	.57408	57.2322	59.4959	34.00	76.00

Table 4a shows the pre-test attitudinal mean scores of the students in LCA (55.6250), ITA (55.1315) and TEA (55.5294) respectively. While the post-test attitudinal mean scores of the students accordingly for each of the groups are LCA (66.6774), ITA (60.5526) and TEA (58.9118). This is an indication that students taught using LCA developed a more positive attitude to Physics compared to ITA and TEA.

Table 4b: One-way ANOVA for the Students' Attitude to Physics Questionnaire in the LCA, ITA and TEA

	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	5210.495	5	1042.099	23.936	.000
Within Groups	8707.199	200	43.536		
Total	13917.694	205			

P>0.05

Table 4b shows that the results of the ANOVA for the students' Physics Attitude Questionnaire among the three groups. The result indicates that, there is a statistical significant difference between the mean scores. The F = 23.936 at P >0.05 significant level and between mean square is greater than within means squares. This implies that, there is significant difference in the attitude of students exposed to LCA and ITA.

To establish where the experimental effect was located, Scheffes' post hoc test was carried out. The result is presented in the table 4c.

Table 4c: Scheffes' Post Hoc Multiple Comparisons of Students' Pre-test and Post-test on Attitudinal Scores

(I) APPROACHES	(J) APPROACHES	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
Pre-test LCA	Post-test LCA	-17.05242*	1.66279	.000	-22.6410	-11.4638
	Pre-test ITA	-5.51014*	1.59284	.039	-10.8636	-.1566
	Post-test ITA	-10.92763*	1.58309	.000	-16.2484	-5.6069
	Pre-test TEA	-9.90441*	1.62511	.000	-15.3664	-4.4425
	Post-test TEA	-9.28676*	1.62511	.000	-14.7487	-3.8248
Post-test LCA	Pre-test LCA	17.05242*	1.66279	.000	11.4638	22.6410
	Pre-test ITA	11.54228*	1.60656	.000	6.1427	16.9419
	Post-test ITA	6.12479*	1.59689	.014	.7577	11.4919
	Pre-test TEA	7.14801*	1.63855	.003	1.6409	12.6552
	Post-test TEA	7.76565*	1.63855	.001	2.2585	13.2728
Pre-test ITA	Pre-test LCA	5.51014*	1.59284	.039	.1566	10.8636
	Post-test LCA	-11.54228*	1.60656	.000	-16.9419	-6.1427
	Post-test ITA	-5.41750*	1.52392	.030	-10.5394	-.2956
	Pre-test TEA	-4.39428	1.56752	.170	-9.6627	.8741
	Post-test TEA	-3.77663	1.56752	.330	-9.0450	1.4918
Post-test ITA	Pre-test LCA	10.92763*	1.58309	.000	5.6069	16.2484
	Post-test LCA	-6.12479*	1.59689	.014	-11.4919	-.7577
	Pre-test ITA	5.41750*	1.52392	.030	.2956	10.5394
	Pre-test TEA	1.02322	1.55761	.994	-4.2119	6.2583
	Post-test TEA	1.64087	1.55761	.953	-3.5942	6.8760
Pre-test TEA	Pre-test LCA	9.90441*	1.62511	.000	4.4425	15.3664
	Post-test LCA	-7.14801*	1.63855	.003	-12.6552	-1.6409
	Pre-test ITA	4.39428	1.56752	.170	-.8741	9.6627
	Post-test ITA	-1.02322	1.55761	.994	-6.2583	4.2119
	Post-test TEA	.61765	1.60029	1.000	-4.7609	5.9962
Post-test TEA	Pre-test LCA	9.28676*	1.62511	.000	3.8248	14.7487
	Post-test LCA	-7.76565*	1.63855	.001	-13.2728	-2.2585
	Pre-test ITA	3.77663	1.56752	.330	-1.4918	9.0450
	Post-test ITA	-1.64087	1.55761	.953	-6.8760	3.5942
	Pre-test TEA	-.61765	1.60029	1.000	-5.9962	4.7609

*. The mean difference is significant at the 0.05 level.

The results in table 4c shows that each approach has effect on students attitude to Physics with the post-test mean score of each approach higher than their pre-test mean score. Specifically, the mean difference of the post-test scores of the LCA (17.05242) was found to be significantly higher than that of ITA (10.92763) and TEA (9.28676). These points to the difference in effectiveness of the approaches in enhancing students' attitude to Physics, with the LCA showing highest effectiveness followed by ITA and the TEA. Based on the results, the hypothesis stating that,

there is no significant difference in the attitude of students taught using LCA, ITA and TEA in Physics is hereby rejected.

3.3 *Discussion*

The result of hypothesis one revealed that students in the experimental groups (LCA and ITA) gained higher scores when their post-test mean scores were compared to their pre-test scores than those in the control group, with the LCA as the most effective. This is an indication that the interventions given have improved their performances in Physics. This agrees with the work of earlier researchers such as Liewellyn (2007), Susanne (2011) and Jill (2007) where they also recorded a significant effect of LCA in enhancing students' performance in Chemistry and other science subjects. Abdul, et al. (2011) also corroborated the result where they described learning-cycle as an approach that ensures students' positive participation, on-task behaviour, and rich collaboration as well as empowering students' ownership and self-directed learning by increasing their involvement and responsibility for their own learning.

The learning-cycle being the leading most effective as noted by Akar (2005) and Deborah (2007) has been capable of enhancing students' performance in science subjects. In the view of Hasret & Necati (2006) in a study on relative effect of learning-cycle model to increase the students' achievement in Physics, revealed that, learning-cycle model is an educational model that helps to resolve the main problems in teaching the scientific knowledge. It facilitates students to learn effectively and organize the knowledge in a meaningful way. It also corroborated the submission of Maudu & Amaechi (2012) in an investigation into the effect of five-step learning-cycle model on students' understanding of concepts related to elasticity found that, the implementation of the learning-cycle model enhances students' understanding of key concepts involved in elasticity. The reason for this observation may be attributed to value associated with alternative ways of acquiring knowledge in science and confirmation of value of hands-on activities which are characteristics of the learning models. The result here seemed not to be in consonance with the result of studies conducted by Mayer (2008) and Moreno (2004) where they discovered that pure inquiry in form of discovery learning makes the students lost, frustrated and confusion leads to misconception and affects performance.

Furthermore, the result from hypothesis two which states that, there is no significant difference in the retention ability of students taught using learning-cycle approach, inquiry-teaching approach and the teacher expository teaching in Physics revealed that, learning-cycle approach and the inquiry-teaching approaches enhances students' retention of Physics concepts with the retention test mean score of students taught using LCA greater than the retention test mean score of the students taught using ITA and TEA. The findings corroborated the results of study conducted by Burkel (2007) where it was discovered that learning-cycle was being able to form a connection between classroom science and students' daily experiences of living which makes learning long lasting. The result also corroborated the finding of Hasret & Necati (2007) which showed that learning-cycle makes scientific knowledge to be long-lasting (retention). Also, it was in agreement with Maudu & Amaechi (2012) in an investigation into the effect of five-step learning-cycle model on students' understanding of concepts related to elasticity where he found that, the implementation of the learning-cycle model enhances students' understanding of key concepts involved in elasticity.

Hypothesis three which was set out to determine the effectiveness of learning-cycle and inquiry-teaching approaches on the students' attitude to Physics indicated that, the learning-cycle and inquiry-teaching approaches shows relative effectiveness in improving the students' attitude to Physics with the learning-cycle as the most effective. The result of this hypothesis elucidated the results of the study conducted by Susanne (2011) where it was discovered that learning-cycle demonstrated modest improvement in overall students' achievement and self-expressed interest, attitude and confidence in Physics. The result is also in line with the study of Barrow (2007) where he described the effect of using learning-cycle as leading the students to the acquisition of skills and the development of positive attitude that permits the students to seek resolutions to questions of meaningful and logical answers.

3.4 Conclusion

The main concern of Physics teachers and educators is the search for efficient and enjoyable ways of communicating Physics concepts to students. Based on the analysis of data and the interpretation of the results of this study, it can be concluded that the LCA produce significantly better performance and retention in Physics than ITA and TEA, therefore LCA is an effective mode of instruction for Physics students in secondary schools. However, in a

typical Physics lesson, an effective teacher normally uses more than one approach. The findings of this study have revealed that LCA and the ITA can be used for teaching and learning of Physics in secondary schools. Learning-cycle was found to be the most effective because it improves the performance of students, enhances retention of concepts and brings about the students' development of positive attitude to Physics.

The findings of this study suggest some teaching approaches as nearly all the students in every Physics classroom experience difficulties in learning Physics as they have to contend with different representations such as experiments, tables of values, laws, formulas and calculations, graphs, conceptual explanation and interpretations at the same time. The use of LCA would be an effective learning strategy for them to overcome many of the problems they might have encountered by the time they engage, explore, explain, elaborate and evaluate Physics concepts.

3.5 *Recommendations*

Based on the findings and conclusions reached in this study, the following recommendations are hereby offered:

- All Physics teachers must have the understanding of the best teaching method(s) that will be required to effectively teach Physics.
- Teacher education programmes should emphasize learning-cycle and inquiry-teaching approaches and in-service teachers should be provided training or refresher course to enable them use learning-cycle and inquiry-teaching approaches in Physics classroom.
- Physics curriculum should be designed incorporating the LCA and ITA.
- Textbooks should be written using the features and hierarchical nature of LCA and ITA to complement the teacher's work in the classroom.

References

Abdul, Q. S., Muhammed, N. Q., & Monzoor, A U, (2011). Measuring students' attitudes towards learning physics: Experimental Research. *Australian Journal of Basic and Applied Sciences,* 5(11); 2282-2288.

Abubakar, U. Y.(2012). Homogenous and non-homogenous markov chain models for Asthma, ABACUS: *The Journal of Mathematical Association of Nigeria (MAN),* Vol. 32 (2B), 262-270.

Agboola, O. S. & Oloyede, E. O. (2007). Effects of project, inquiry and lecture demonstration teaching methods on senior secondary school students' achievement in separation of mixture practical test. *Education research and review.* Vol. 2 (6) pp 124-132. Available online at http://www.academicjounals.org/ERR. ISSN 1990-3839.

Akar, E. (2005). Effectiveness of E learning cycle model of instruction on students' understanding of acid-base concepts. *Unpublished M.Sc thesis. Middle East Technical University.*

Barrow, C. I. (2007). Classroom interaction analysis of high school biology classes in Israel. *Science Education,* 71, 87-103.

Bello, T. O. (2011). Effects of group instructional strategy on students' performance in selected Physics concepts. *The African Symposium: An online journal of the African Educational Research Network.* Volume 11 (1), 71-79.

Bello, T. O. (2012). Effect of availability and utilization of Physics laboratory equipment on students' academic achievement in senior secondary school. *World Journal of Education,* Vol.2 (5), 1-7. www.sciedu.ca/wje

Burkel, J. (2007). Now What? *Forbes.* October 4, 2007. Retrieved November 15, 2007.www.forbes.com

Cambell, D. T. & Stanley, J. (1966). Experimental and Quasi-experimental designs for research. *Holts, Rinechart and Winston.* New York.

Craker, D. E. (2006). Attitude of science students' enrolled in introductory level science courses at UW-Lacross. *UW-L Journal of Undergraduate Research,* 9, 1-6.

Deborah, L. H. (2007). Using a learning cycle approach to teaching the learning cycle to pre-service elementary teachers. *Paper presented at the 2007 annual meeting of association for science teachers education,* Clearwater, FL.

Esiodu, G. O. (2005). Gender Issues in science and technology education development. *Science and Technology Education Development,* In Uwowi, U.M.O. (Ed.). NERDC Press, Lagos, pp: 137-156.

Hasret, N. & Necati, Y. (2006). The effectiveness of learning cycle model to increase students' achievement in physics laboratory. *Journal of Turkish Science Education.* Volume 3, Issue 2. December, 2006.

Jacinta, A. O. & Nkasiobi, S. O. (2011) Inquiry teaching instructional method and school science curriculum. *Current research journal of social sciences* 3(3): 188-198.

Jill, S. (2007). Collaborative teaching in GS, 'A workshop to help new General Studies instructors prepare their syllabi. Califonia State University, East Bay.

John, W. M. & Muhammed, I. B. (2004). Using inquiry approach to teach science to secondary school science teachers. *Physic Education. 39(5) 10P Publishing Ltd.*

Liewellyn, D. (2007). Teaching high school physics by inquiry. A case study of Approach *Thousand Oaks: Corwin Press.*

Maudu, B. C. & Amaechi, C. C. (2012). Effects of five steps learning cycle model on students' understanding of concepts related to elasticity. *Journal of Educational and Practice. Vol.3 (9). ISSN:2222-288X. www.iiste.org.*

Mayer, R. E. (2008). Learning and Instruction. *2nd Edition. Upper Sadddle River. NJ: Pearson Education Inc.*

Moreno, R. (2004). Decreasing cognitive load in novice students: Effects of explanatory versus corrective feedback in discovery-based multimedia. *Instructional Science,* 32, 99-113.

Nwagbo, C. (2011). Effect of guided inquiry and exposition teaching methods on the achievement in an attitude to Biology of students of different scientific literacy. *Online at http://www. pepreal.cl.*

Ogunleye, A. O (2002). Towards the optimal utilization and management of resources for the effective teaching and learning of physics in school. *Proceedings of the 41st Annual Conference of the Science Teachers' Association pf Nigeria, (STAN). University of Lagos,* Nigeria, pp: 215-220.

Oladejo, M. A., Olosunde, G. R., Ojebisi, A. O. & Isola, O. M. (2011). Instructional materials and students' academic achievement in physics: Some policy implications. *European Journal of Humanities and Social Sciences. 2 (1) http://www.journalsbank.com/ejhst.htm.*

Olorundare, A. S. (2011). Correlates of poor academic performance of secondary school students in the sciences in Nigeria. A paper presented at the Virgina State University, Pertersburg, Virgina. USA.

Schwab, J. I. (1962). The teaching of science as inquiry. *The teaching of science*. HarvardUniversity Press.

Susanne, L. H (2011). Improving students' achievement, interest and confidence in science through the implementation of 5E learning cycle in the middle grades of an urban school. *A professional Paper Submitted in partial fulfillment of the requirements for the degree of M. Sc. Ed. Mount Ana State University, Bozeman, Montana.*

West African Examination Council (WAEC). *2013 Chief Examiners' Report.* Lagos.