

Effect of Videotaped Instruction and the Learning Cycle Constructivist Model on Secondary School Physics Students' Interest and Achievement

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Abstract: *The purpose of this research was to investigate the effect of videotaped instruction, and the TLC method on secondary school students' interest and achievement in physics. The study adopted the quasi-experimental research design. Specially, the study was non-randomized pretest posttest control group design. This design was chosen because intact classes were used for the study. Umuhia North Local Government Area of Umuhia Education Zone of Abia State was purposively sampled because it has the highest number of co-education secondary schools. Four co-educational secondary schools in Umuhia North LGA were selected. Out of the four schools selected, two were randomly assigned to videotaped treatment group and two to TLC treatment group. A total of 243 SS2 physics students formed the sample for the study. The instruments used in this study are Physics Achievement Test (PAT) and Interest Inventory Test (IIT). The PAT was in form of paper and pen test that included 10 questions in essay formats which measured the students' knowledge and subsequent understanding and application of physics concepts. The IIT consisted of 25 items and each of the items was rated on a 4-point scale with response type of Strongly Agree (SA), Agree (A), Disagree (D) and Strongly Disagree (SD). These were weighted as 4, 3, 2 and 1 respectively. The instruments were validated by experts in both measurement and evaluation and physics education. An internal reliability of 0.80 was obtained using Cronbach Alpha while the coefficient of stability for the PAT and IIT was established using spearman's test-retest coefficient of reliability and were found to be 0.91 and 0.92 respectively. The research questions were answered by computing the mean scores and standard deviation of both groups while the hypotheses were tested at $P < .05$ probability level using Analysis of covariance. Findings show that the use of both TLC and videotaped methods improved students' achievement and interest in physics but with the use of TLC constructivist instructional method enhancing students' achievement and interest in physics concepts better than the videotaped method. Gender had consistent influence over interest and achievement. Male students seemed to perform better than their female counterparts relative to their interest and achievement in physics concepts. The implication of this is that classroom teachers should design teaching strategies that can help students overcome their difficulties in learning and interpreting physics concepts. The TLC and videotaped methods of teaching physics should be adopted in secondary schools. Physics teachers should be trained on the effective use of such methods through seminars, workshops and conferences. Curriculum developers in science education should adopt these methods in restructuring the physics curriculum in our secondary schools. It is therefore expected that with improved scores in physics, the much expected scientific literacy and technological development may become a reality.*

Keywords: *Videotaped Instruction, Physics, Achievement, Interest and The Learning Cycle.*

I. Introduction

Science and Technology have been instruments per excellence for nation building and wealth creation since the development of a nation depends on the level of its scientific and technological literacy. According to Eze (2003s), the height attained by any nation in Science and Technology and in fact, over all development is usually a reflection of the quality of Science, Technology and Mathematics (STM) education at various levels of the country's educational system.

Physics which is one of the sciences is highly needed for our nation's technological breakthrough and advancement. Physics is a science that studies the most fundamental rules in the universe. It deals with matter, energy, their behaviour and structure. The study of physics enhances an understanding of the interplay of forces in nature and therefore forms veritable armour against superstition which helps technological advancement everywhere. Stressing on the importance of physics, Adeyemi (2003) and Oraifo (2005) opined that physics plays very important role in scientific and technological advancement that affects the lives of mankind. The importance of physics education to the nation's development has led to the increase emphasis on the use of appropriate instructional approaches. Findings from this study could be very useful to the students in the sense that those having difficulties in their conception of physics concepts before instruction change and improve after

instruction thus increasing their understanding of physics concepts. Students' active learning capacity will be enlarged and this may elevate their knowledge level in physics concepts. The importance of physics education to the nation's development has led to the increase emphasis on the use of appropriate instructional approaches. Findings from this study could be very useful to the students in the sense that those having difficulties in their conception of physics concepts before instruction change and improve after instruction thus increasing their understanding of physics concepts. Students' active learning capacity will be enlarged and this may elevate their knowledge level in physics concepts. This implies that physics has to be taught properly at the secondary school level for our country to develop scientifically and technologically.

Despite all the efforts made by physics educators to improve the teaching of physics, physics learners have been observed to demonstrate low achievement in physics examinations (Oraifo, 2005). Empirical evidences revealed that students' scientific literacy levels are low and that students have difficulties mastering the concepts and principles outlined in the science curricula especially in physics (Njoku, 2002; Eze, 2003; Nwagbo, 2006). Poor performance in physics and its effect on the scientific and technological development of the country has been the major concern of many physics educators. These poor performances as observed over the years could be as a result of the methods used in the teaching of physics which has made the subject very unpopular on the part of the students (Ayodele, 2002). Researchers have indicated that science and physics learning in particular is a constructive process and knowledge construction which requires active participation on the part of the learner and the teacher (Achor, 2001). To construct knowledge, students must identify and test their existing understanding, interpret the meaning of their on going experience and adjust their knowledge framework accordingly (Madu, 2004). Hence the need to explore the effects of videotaped instruction and The Learning Cycle (TLC) constructivist model on secondary school physics students' interest and achievement since researchers have indicated that science learning is a constructive process and knowledge construction which requires participation on the part of the learner and their teacher (Achor, 2001).

Videotaped instruction is an instructional tool that has high potential in the teaching and learning situations. Videotapes have the quality of being able to provide semi permanent, very complete and audiovisual records of events. They have the potentials of increasing the probability that students will learn more, retain better and even improve their performance of the skills they are expected to develop. Educational technologists as well as curriculum experts have proved that videotaped instruction has high potential in the teaching and learning situation for it can multiply and widen the channels of communication between the teacher and the students (Osokoya, 2007; Curzon, 1991). Adams (1990), is of the opinion that videotaped instruction is one of the most influential of all the media for teaching as a result of its power of both sight and sound. Banford and Western (1997) reiterated that the benefits of colour, sound and motion attached to the videotaped packed will be of interest to students who are the target of the study. Literature has also established that videotaped instruction has greatly improved the performance of children with special needs and slow learning abilities (Aremu, 1992; Metchell, 1994; Okwo, 1994).

The Learning Cycle (TLC) constructivist instructional model as published by Akin and Karplus (1962) is an instructional model that comprises of concept discovery, concept instruction, and concept application. The use of TLC constructivist model by teachers may bring about greater understanding and improvement in achievement since constructivism is a set of belief about knowledge and learning which emphasizes the active role of the learners in constructing their own knowledge (Nworgu, 1996). The TLC model will provide the learner the opportunity to test his perception against actual experience from his own activities and apply the new experiences in order to experience its usefulness.

Piaget's theory of cognitive development emphasized ideas about reasoning that were assumed to affect the organization of knowledge as the learner continually interacts with the world around him and solving problems that are presented by the environment (Clark, Nguyen and Sweller, 2006). This aspect of Piaget's work has been supported in many regards (Meyer, 2009; Sweller, 2003; Branford, Brown and Cocking 2000). Sweller, (2003) claimed that knowledge can be organized by taking into account the background and culture of the learner through the learning process since this background helps to shape the knowledge and truth the learner creates, discovers and attains in the learning process. This is in line with the constructivist approach to knowledge construction which emphasis a learning that allows the students to experience his environment first – hand thereby giving him reliable and trust- worthy knowledge. The similarities between Piaget's cognitive development and the constructivist approach to learning has been recognised in science education and this has resulted in the call to use these approaches as a way forward to knowledge construction by many science researchers. Holt and Willard- Hord (2000) suggest that for conceptual change to occur in science learning, these approaches should be used in the teaching of science subjects. Benarroch and Jimenez (2000) explained how the general characteristics of conception can be lodged within the framework of Piagetian constructivism and that Piaget's theory has the capacity to explain a large number of general characteristics of conceptions. This research work is based on the work of Madu (2004) which explained that cognitive processes are

perception, learning, thinking cognition, imagining, judging, discovery, thinking and that cognition involves and includes processes by which a being obtain knowledge of some objects and becomes aware of them.

Interest is a feeling somebody has when he or she wants to know or learn more about something. Interest in physics could be achieved when students are made to see the importance of what they are about to learn. Ainkey, Hidi & Bemdorff (2002) explained that interest has been conceptualized both as an individual predisposition and as a psychological state. They went further to state that this psychological state is characterized by focussed attention, increase cognitive and affected functioning and persistent effort. As this study tries to find out the instructional approaches that will facilitate the learning of scientific conceptions; it may then provide a framework for considering learning processes involved in changing students' difficulties in their conception. The performance of students relative to the increase in interest and improvement in achievement of physics concepts will provide a basis for decision on whether or not videotaped instruction and the learning cycle methods when compared should be adopted in our educational system.

Considering the educational value of videotaped instruction and the learning cycle approaches, policy makers of education ministries will be stimulated on the need for a constructivist-based curriculum and instruction which will help students improve in their physics concepts conception thereby ensuring effective teaching and learning of physics.

The influence of student's gender in their achievement in physics has been a concern to education researchers for long. Some studies showed that male students achieve better those female studies in physics (Ogu, 1995, Madu, 2004; and Ogbonna, 2004). Other studies that female students achieve better than students (Ocho, 1997; Nkpa, 1997). In the studies carried out by Ifeancho (2002), Aiyedun (2000) and Agommuoh (2004) gender was found to play no significant role in physics achievement. This makes gender issues inconclusive.

The purpose of this study is to investigate the effect of videotaped instruction, and the TLC method on secondary school students' interest and achievement in physics.

Research Questions

The following research questions guided the study.

1. What are the mean achievement scores of students taught physics using videotaped instruction and those taught using the TLC methods?
2. What are the mean interest scores of students taught physics using videotaped instruction and those taught using the TLC methods?
3. What are the mean achievement and interest scores of male and female students taught physics using videotaped instruction and those taught using TLC method.

Hypotheses

The following hypotheses tested at $P < 0.05$ guided the study.

H0₁: There is no significant difference in the mean achievement scores of students taught Physics using videotaped instruction and those taught using TLC method.

H0₂: There is no significant difference in the mean interest scores of students taught Physics using videotaped instruction and those taught using TLC method

H0₃: There is no significant difference in the mean achievement and interest scores of male and female students taught physics using videotaped instruction and those taught using TLC method.

II. Methodology

Design

The study adopted the quasi-experimental research design. Specially, the study was non-randomized pretest posttest control group design. This design was chosen because intact classes were used for the study.

Sample and Sampling Technique

Umuahia North Local Government Area of Umuahia Education Zone of Abia State was purposively sampled because it has the highest number of co-education secondary schools. Four co-educational secondary schools in Umuahia North LGA were selected. Out of the four schools selected, two were randomly assigned to videotaped treatment group and two to TLC treatment group. A total of 243 SS 2 physics students formed the sample for the study.

Instrument for Data Collection

The instruments used in this study are Physics Achievement Test (PAT) and Interest Inventory Test (IIT). The PAT was in form of paper and pen test that included 10 questions in essay formats which measured the students' knowledge and subsequent understanding and application of physics concepts. The IIT consisted of

25 items and each of the items was rated on a 4-point scale with response type of Strongly Agree (SA), Agree (A), Disagree (D) and Strongly Disagree (SD). These were weighted as 4, 3, 2 and 1 respectively. The instruments were validated by experts in both measurement and evaluation and physics education.

An internal reliability of 0.80 was obtained using Cronbach Alpha while the coefficient of stability for the PAT and IIT was established using spearman’s test-retest coefficient of reliability and were found to be 0.91 and 0.92 respectively.

Data Analysis

The research questions were answered by computing the mean scores and standard deviation of both groups while the hypotheses were tested at P <.05 probability level using Analysis of covariance.

III. Result

The result in respect of mean and standard deviation of students overall achievement scores is shown in table 1.

Table 1: Mean and standard deviation of students’ overall achievement scores using videsotaped instruction and TLC method

Method	Gender	Pretest			Posttest		
		Mean	SD	N	Mean	SD	N
TLC	Male	2.18	1.46	82	23.90	4.42	80
	Female	2.58	1.41	48	23.81	3.67	48
	Overall	2.33	1.45	130	23.87	3.67	128
Videotaped	Male	3.46	1.69	57	21.53	2.80	57
	Female	2.53	1.39	58	21.31	2.85	58
	Overall	2.99	1.61	115	21.42	2.81	115

The result in table 1 clearly showed that the mean achievement scores of TLC group were higher than that of students in the Videotaped group. Table 1 also showed that male students in both groups scored higher than their female counterparts.

The result in respect of the mean interest scores and standard deviations of students in both groups is shown in table 2.

Table 2: Mean interest scores and standard deviation scores of students in both groups.

Method	Gender	Pre-IIT			Post IIT		
		Mean	SD	N	Mean	SD	N
TLC	Male	1.58	0.11	82	3.59	0.08	80
	Female	1.34	0.09	48	2.42	0.06	48
	Overall	1.72	0.21	130	4.25	1.01	128
Videotaped	Male	1.45	0.12	57	3.28	0.57	57
	Female	1.30	0.08	58	2.34	0.05	58
	Overall	1.68	0.20	115	3.95	1.12	115

Result in table 2 showed that the mean interest scores of those on the TLC group are greater than that of the students in the videotaped group. The table also showed that male students in both groups have higher mean interest scores than their female counterparts.

The ANCOVA results in respect of students’ overall achievement scores by instructional approaches and gender is shown in table 3 below.

Table 3: Analysis of covariance of students' overall achievement scores by instructional approaches and gender

Source of Variance	Sum of Squares	DF	Mean	F	Sign of P
Pretest	8.303	1	8.303	.761	.32
Main Effects	324.172	2	106.076	17.447	.00
Gender	.012	1	.012	.001	.86
Treatment	402.233	1	402.233	35.405	.00
Gender*treatment	2.566	1	2.566	.214	.52
Explained	414.132	4	105.011	9.047	.00
Residual	2398.747	237	9.553		
Total	2812.879	241	11.146		

Table 3 above reveals that instructional approaches as main effects are significant on the students achievement in physics ($p = .00$). At .05 level of significance, there is a significant difference in the mean achievement scores of students taught with videotaped instruction and those taught using the TLC approach. The table further revealed that gender is not significant on students' achievement at .05 level of significance. This implies that the null hypothesis is not rejected meaning that there is a significant difference in the mean achievement scores of male and female students taught physics using both methods.

The ANCOVA results in respect of students' overall interest scores by instructional approaches and gender is shown in table 4 below.

Table 4: Analysis of covariance of students' overall interest scores by instructional approaches and gender

Source of Variance	Sum of Squares	DF	Mean	F	Sign of P
Covariates	2261.463	1	2261.463	2790.505	.00
Main Effect	24.802	2	12.402	15.303	.00
Treatment	14.842	1	14.842	18.314	.00
Gender	6.865	1	6.865	8.470	.00
2 – Way Interaction					
Treatment* Gender	3.276	1	3.276	4.043	.04
Explained	2289.543	4	572.386	706.288	.00
Residuals	189.543	236	.810		
Total	2479.180	240	10.418		
TLC	4.178	1	4.178	4.584	.03
Videotaped	1.122	1	1.122	1.206	.27

Table 4 revealed that the main effect has a significance of .00, which is less than .05. This means that the instructional approaches as the main effect is significant on the students' interest in physics. This implies that the null hypothesis will be rejected in favour of the alternative. Therefore there is a significant difference due to the instructional approaches on students' mean interest scores. The significance of TLC effect is 0.03 which is less than 0.05 and the significance of Videotaped effect is 0.27 which is greater than 0.05, showing that there is a significant difference between the mean interest scores of students taught with TLC method and those taught with videotaped method with TLC method enhancing the interest of students more than the videotaped method. The result also showed that there is a significant difference in the mean interest scores of male and female students taught physics using both methods.

IV. Discussion

The mean interest and achievement scores of students taught with both TLC method and videotaped instruction was found to improve with that of those taught with TLC method higher than that of those taught with video taped instruction. This implies that TLC method facilitated students' interest and achievement of physics concepts better than the videotaped instruction. This is because TLC method provides the students with a lot of time, productive engagement to be obtained through activities that proceed through a planned sequence of structured concept invention and concept application activities. This result is in consonance with the opinion of Okebukola (2002) that the learner advances through Assimilation, Accommodation and Equilibrium. The result also agrees with the work of Madu (2004) who found out that constructivist based methods are significant in enhancing achievement.

From the result, both male and female students improved in their interest and achievement scores but with male students having slightly higher mean achievement scores than their female counterparts. This result agrees with the findings of some studies (Madu, 2004; Agommuoh, 2004; Ogbonna, 2007) which indicated that there was significant difference between achievement of male and female students in science learning. The result also showed a significant difference in the mean interest scores of male and female students. This is in agreement with the findings of Koller, Baumert and Schnabel (2001) who recorded sex difference in students' interest in science in favour of boys.

V. Conclusion

The use of both TLC and videotaped methods improved students' achievement and interest in physics but with the use of TLC constructivist instructional method enhancing students' achievement and interest in physics concepts better than the videotaped method. Gender had consistent influence over interest and achievement. Male students seemed to perform better than their female counterparts relative to their interest and achievement scores in physics concepts.

VI. Recommendation

It is recommended that classroom teachers should design teaching strategies that can help students overcome their difficulties in learning and interpreting physics concepts. The TLC and videotaped methods of teaching physics should be adopted in secondary schools. Physics teachers should be trained on the effective use of such methods through seminars, workshops and conferences. Curriculum developers in science education should adopt these methods in restructuring the physics curriculum in our secondary schools. It is therefore expected that with improved scores in physics, the much expected scientific literacy and technological development may become a reality

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