

Effect of Individualised Instruction and Structured Inquiry Method on Physics Retention among Secondary School Students in Akwa Ibom State

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Abstract

The study investigated the effects of individualized instruction and structured inquiry method and physics retention among secondary school in Akwa Ibom State. The research was guided by two research questions and two null hypotheses was tested at 0.05 level of significance. The study employed pre-test, post-test quasi experimental design. The target population of the study consists of 2,114 SS II students, made up of 1,077 males and 1,037 females in Ikot Ekpene Education Zone. Simple random sampling technique was used in the selection of the Education Zone while purposive sampling technique was used in the selection of three schools out of the eight government owned secondary schools in the Education Zone. A validated researcher-made instrument, namely, Physics Retention Test (PRT) was used for collection of data. The reliability coefficient of the instrument was found to be 0.813 using Kuder Richardson 20 formula. Descriptive statistics (mean and standard deviation) were used to answer the research questions while the analysis of covariance (ANCOVA) was used in testing the hypotheses at 0.05 level of significance. The findings of the study showed that students taught physics using individualized instruction and structured inquiry method retained physics concept significantly better than their counterpart taught using lecture method. Also, male students retained physics concepts slightly but not significantly better than their female counterparts when exposed to individualized instruction and structured inquiry method. Based on the findings of the study, it was recommended that serving secondary school physics teachers should embrace individualized instruction and structured inquiry method in teaching physics topics in order to enhance the students' retention of the concepts being taught.

Keywords: Individualized instruction, Structured inquiry, Retention, Physics students, Schools

Introduction

Physics is the study of matter and natural events, based mostly on empirical observations and quantitative measurement. Ojediran, Oludipe and Ehindero (2014) defines Physics in two ways, that is, Physics as a process and as a product. As a process, Physics has to do with the skills that are called into play by scientists in carrying out scientific investigation. As a product, Physics is viewed as consisting of scientific facts, principles, laws and

generalizations derived from scientific investigations. Ojediran, Oludipe and Ehindero (2014) holds the view that Physics will remain as the fundamental science because many of the tools on which the scientific and technological advancement depends are the direct products of Physics. Generally, a good performance in Physics by students is essential for technological advancement of any nation. Unfortunately, in Nigeria, students' attitude towards Physics and their performance have been very poor over the years especially in secondary schools. These unsatisfactory results have been attributed to many factors which include non-utilisation of appropriate methods of instruction and dearth of qualified and experienced physics teachers (Boyo, 2010; Mankilik & Josiah, 2013; Sule & Mankilik, 2015).

The lecture method which is still the most frequently employed mode of instruction by physics teachers in Nigeria is teacher centred and considered often as inappropriate (Sule & Mankilik, 2015). Student centred strategies such as individualized and structured inquiry mode of instruction are considered engaging and are expected to improve students' participation, performance and retention. Individualized instruction is a method of teaching in which the teacher prepares the lesson, writes out the instructional objectives on paper, lists the tasks to be performed, gives out materials to learners and assesses the students individually while the students on the other hand may decide the objectives they will achieve, the procedure and the materials they will use as well as how much time they will devote (Udeinya & Okobia, 2011). Udu (2017) opined that individualised instruction is a form of individual instruction which involves a student working on his/her own, the purpose of which is to increase the student's ability to take responsibility for his/her own learning. Individualization is based on the professional competence in making and implementing instructional decisions relevant to each learner.

Udeinya and Okobia (2011) observed that individualised instruction is student oriented and multi-dimensional method with many approaches to cater for individual differences. Also, understanding the subject matter by the student is enhanced as the teacher is aware of individual differences and selects different methods to accommodate these individual differences. Udu (2017) supported the fact that when methods are varied to suit individual students and their differences as well as learning objectives, learning content and materials, general performance of such students will be greatly increased. According to Udeinya and Okobia (2011), the strategy is advantageous because the answer or solution of a problem lies mainly with the individual students, with the teacher acting merely as a guide. The method arouses interest and makes students to act independently and learn what to do in difficult situations as supported by the behaviourist theories. Individualized instruction is one way to achieve mastery learning which suggested that the amount of materials that students can learn is a function of the time allowed for learning those materials, divided by time that the students need for learning it (Udu, 2017).

The major factor here is time; time is required by a student for moving from ignorance to understanding and from unskilled performance to skilled performance. Udeinya and Okobia (2011) explained that educationists have come to agree that no two students are exactly the

same in their learning style. Hence, the need for individualization of the teaching process in our schools. The author further explained that teachers most often do not complete their curriculum before the students are set out to write examination. They do not give students enough time to study on their own, which is why the slow learner gets lower grade.

On the other hand, Etuk & Afangide (2008) reiterated that the operating principle of individualized teaching is understanding the importance of the learner as central to the teaching/learning process, pointing from a larger teacher-oriented process to one where a student can take responsibility for the progress. The authors explained that most science educators know that teaching is most effective when teachers take into account individual differences in students. Ikite and Edet (2005) asserted that since individual differences influence the ways in which the individual student learns and performs, it is expected that differential instructional strategies be adopted in teaching science to ensure high academic achievement in Physics. The authors also added that acknowledging individual differences has resulted in the adoption of great practices, project work, independent study and remedial system employed to adapt teaching/learning process to student' differences.

Another teaching strategy which is student centred is the Structured Inquiry Method. Structured inquiry method is a technique that encourages students to discover or construct information instead of a teacher directly revealing the information and hence ensure better retention of the concept learnt (Huziak-clark, Van, Hook, Nurnberger-Haag & Ballone-Duran, 2007). Inquiry based learning includes students constructing knowledge and understanding through the teacher's encouragement to explore the world, discover knowledge, reflect and think critically. Inquiry based learning falls under the realm of 'inductive' approaches to teaching and learning, an excellent review of which is provided by Prince and Felder (2006) and National Institute for Health (2005) as involving developing questions, making observations, doing research to find out what information is already recorded, developing methods for experiments, developing instruments for data collection, collecting, analysing and interpreting data, outlining possible explanation and creating predictions for future study.

Cheval and Hart (2005) classify inquiry teaching method into three (3) classes, namely structured inquiry, guided inquiry and open inquiry. All these types of inquiry can be useful to students to learn science when taught appropriately. Structured inquiry is the most teacher-centred of the three types of inquiry. This type of inquiry is commonly seen in science classrooms in the form of laboratory exercises. The teacher provides fairly structured procedures for the inquiry activity, and students carry out the investigations. Structured inquiry could be described as the most tradition approach to inquiry (Cheval & Hart, 2005). The open inquiry on the other side is a type of inquiry which requires the least amount of teacher intervention and is student centred. Students, in this case, often work in groups and plan all phases of their investigations, while guided inquiry is commonly used when students are asked to make tools or develop a process that results in a desired outcome.

Individualized and structured Inquiry modes of instruction when used appropriately are expected to result to better understanding of physics concepts which the students will not easily forget. In other words, students' retention is expected to be improved. This is because the students think critically and are fully involved in their learning. Retention refer to the ability to remember and apply knowledge and skills over an extended period of time. It serves as crucial indicators of the effectiveness of teaching and learning process. Retaining information over time is fundamental to educational processes. It comprises of short-term and long-term memory. In short-time memory, information is stored temporarily while in long-term memory, information is stored permanently. Retention is an indicative of deeper learning and comprehension. Retaining the concept that has been learnt is a very crucial issue in the study of Physics and is one of the variables that enhance students' achievement in Physics. Agonmuoh (2010) explained that the concept of retention is the ability to remember effectively when experiences are passed across to the learner through an appropriate instructional strategy which is capable of arousing students' interest. Retention is therefore a necessary factor for students to properly apply learnt concept. It is the ability to store facts and remember things easily. This implies that if there is no proper storage structure developed in the learners, information recalling may be marred and consequently resulting to poor achievement.

The retention of physics concepts by students using individualized and structured inquiry teaching methods may or may not be dependent on gender. Although, male and female students are expected to benefit and retain learnt concepts using these methods, which retain better is still unknown. This is because there are different findings on gender matters in educational researches, some in favour of males, others in favour of females and sometime no gender differences are found.

In a study undertaken by Inyang and Josiah (2016) on perceived difficulty of physics concepts in secondary schools, it was found out that male student achieved slightly higher than their female counterparts. The researchers attributed their difference to Physics-related subject and general lack of interest in science by female students. Other studies, such as that of Ojedirin, Oludipe and Ehindero (2014) showed that female students retained learnt concepts better than their male counterparts in Physics.

Empirical evidence has shown that teachers in Nigerian schools seldom use other teaching methods aside from conventional methods such as expository and lecture methods (Abdullahi, 2019). This approach has persistently not been yielding desired result. Hence the need to explore other strategies of teaching. The present study therefore, set to empirically find out the effect of individualized instruction and structured inquiry on physics retention among secondary school students in Akwa Ibom State.

Statement of Problem

The inability to reproduce concepts learnt by secondary school physics students at Senior Secondary Certificate Examinations (SSCE) in Nigeria has been quite unsatisfactory over the years as evident in the low performance of the students at West African Senior School

Certificate Examination (WASSCE) and National Examination Council's (NECO) SSCE. According to West African Examinations Council (WAEC) and NECO Chief Examiner's Reports of 2019, 2020, 2021, 2022 and 2023, students' performance in senior secondary school physics examination is very low. These reports suggested that the failure of students to reproduce learnt physics concepts and principle could be attributed to teaching and learning methods employed by physics teacher in teaching Physics. Current studies on how students learn Physics revealed new ideas and instructional approaches for the teaching of Physics. These studies indicated that one of the ways of seeking solution to issues of failure is by comparing methods so as to identify the ones that are more suitable for solving different problems which in turn will aid students' understanding of the concepts and principles. Based on this, the present study sought to find out, if the teaching of Physics concepts in senior secondary schools using individualised instruction and structured inquiry method rather than the conventional approach (lecture method) could result to higher academic retention.

Purpose of the Study

The purpose of the study is to determine the effects of individualised instruction and structured inquiry method of teaching on students' retention among secondary school physics students in Akwa Ibom State. Specifically, the study would find out the effect of:

1. Individualised instruction and inquiry method on students' retention in Physics.
2. Individualised instruction and inquiry method on students' retention in Physics based on gender.

Research Questions

The following research questions were raised and answered in this study.

1. What are the mean retention scores of students in Physics when taught with individualised instruction, structured inquiry and lecture methods?
2. What are the mean retention scores of male and female students in Physics when taught with individualised instruction, structured inquiry and lecture methods?

Research Hypotheses

The following null hypotheses were formulated and tested at the 0.05 level of significance

H₀₁ There is no significant difference in the mean retention scores of students in Physics when taught with individualised instruction, structured inquiry and lecture methods.

H₀₂ There is no significant difference in the mean retention scores of male and female students in Physics when taught with individualised instruction, structured inquiry and lecture methods.

Methodology

The study employed quasi experimental design. The population of the study consisted of 2,114 Senior Secondary Two students made up of 1,077 males and 1,037 females in Ikot

Ekpene Education Zone in Akwa Ibom State. Simple random sampling technique was used in the selection of the Education Zone while purposive sample technique was used in the selection of three schools out of the eight-government owned secondary schools in Ikot Ekpene Education Zone in Akwa Ibom State. Those schools became experimental groups and control group with a sample size of 150 students consisting of 50 students for individualised instruction, 50 students for structured inquiry method and 50 students for control group. The research was guided by two research questions and two null hypotheses tested at 0.05 level of significance. A validated researcher-made instrument titled ‘Physics Retention Test (PRT)’ was used for collection of data. The reliability coefficient of the instrument was established using Kuder Richardson 20 formula which was 0.813. The researchers visited the study area and obtained permission from the school administrators to use the facilities and students for the study. The subject teachers of the schools were briefed to assist the researchers in the use of the validated instructional strategies to ascertain their retention abilities. The briefed subject teachers were exposed to mock teaching session using the lesson and instruction materials and subsequently taught the students, administered the PRT twice at an interval of two weeks. The administered PRT were marked and recorded. The recorded scores obtained were analysed using the descriptive statistics of mean and standard deviation in order to answer the research questions and inferential statistic of the Analysis of Covariance (ANCOVA) in testing the research hypotheses at 0.05 level of significances.

Results

Research Questions

Research Question 1: What are the mean retention scores of students in Physics when taught with individualized instruction, structured inquiry and lecture methods?

Table 1: Mean Retention scores of students in Physics when taught with individualized instruction, structured inquiry and lecture methods?

S/N	Group	N	Post-test		Retention		Mean Diff
			X	SD	X	SD	
1	Individualized	50	31.32	4.80	35.46	4.92	4.14
2	Inquiry	50	27.60	4.70	30.52	3.35	2.92
3	Lecture	50	21.74	4.41	23.66	3.61	1.92
	Total	150	26.889	6.08	29.88	6.29	

The result in Table 1 shows the mean post-test and mean retention scores of students who were taught with individualized instruction, structured inquiry and lecture methods. It could be observed in Table 1 that students who were taught with individualized instruction had the highest mean difference of 4.14 as against 2.92 by those who were taught with structured inquiry method. The lecture method had the lowest mean difference of 1.92. This result

suggests that individualized instruction and structured inquiry method enhance students' retention in physics than lecture method.

Research Question 2: What are the mean retention scores of male and female students in Physics when taught with individualized instruction, inquiry and lecture methods?

Table 2: Mean retention scores of male and female students in Physics when taught with individualized instruction, structured inquiry and lecture methods?

Method	Gender	N	Post Test		Retention		Mean Diff
			$\bar{X}$	SD	$\bar{X}$	SD	
Individualized	Male	26	33.31	2.19	38.69	1.2	5.38
	Female	24	29.17	5.88	31.96	5.03	2.79
	Total	50					
Inquiry	Male	26	27.54	4.79	31.69	2.15	4.16
	Female	24	27.67	4.71	29.25	3.93	1.58
	Total	50					
Lecture	Male	22	21.50	4.51	23.82	3.50	2.32
	Female	28	21.93	4.40	23.54	3.76	1.61
	Total	50					

The result in Table 2 shows the mean post-test and mean retention scores of male and female students who were taught with individualized instruction, structured inquiry and lecture methods. The result shows that male students retained physics concept better than their female counterparts in all the groups since the mean difference of male students are greater than those of the female counterparts in all the groups ($5.38 > 2.79$; $4.16 > 1.58$; $2.32 > 1.61$). In addition, it could be suggested that the retention scores of male and female students in individualized instruction group are higher than those of male and female students in inquiry and lecture group.

Research Hypothesis : There is no significant difference in the mean retention scores of student when taught with individualized instruction, structured inquiry and lecture methods.

Table 3: Summary of Analysis of Covariance of Mean Retention Scores of Male and female student in physics when taught with individualized instruction, structured inquiry and lecture methods.

Source of variation	Sum of Squares	df	Mean Square	F	Sig.
Decision					
Corrected model	4187.81(a)	6	69.97	58.71	.000
Intercept	4746.16	1	4746.17	399.23	.000
Pre-test	34.74	1	34.74	2.92	.000
Group	2069.81	2	1034.91	87.05	.000
S					
Gender	402.18	1	402.18	33.83	.28
NS					
Group & Gender	258.19	2	129.10	10.86	.000
S					
Error	1700.03	143	11.89		
Total	139810.00	150			
Corrected Total	5887.84	149			

R-squared = .711 (Adjusted R – Squared = .699)

S= Significant at .05 alpha level; NS = Not Significant at .05 alpha level

The data in Table 3 shows the result of the Analysis of Covariance (ANCOVA) conducted to test for significant difference in the mean retention scores of students in Physics among those taught with individualised instruction, structured inquiry and lecture method. as well as the interaction effect of instructional method and gender on students mean retention scores. The result reveals that the calculated F- value for group (teaching methods) is 87.05 with p-value of 0.000. On this basis, null hypothesis H_{01} is rejected implying that there is significant difference in the mean retention scores of students in physics when taught with the methods.

To ascertain where the significance lies, the post hoc pair-wise comparison of the mean retention of the students in the three groups was conducted as shown in Table 4.

Table 4: The post hoc pair-wise comparison of the mean retention scores of students in the three groups.

Groups	Mean Differences	Standard Error	Sig
1 vs 2	4.94	0.80	0.000
1 vs 3	11.80	0.80	0.000
2 vs 3	6.86	0.80	0.000

Table 4 reveals that the mean difference between group 1 (individualized) and group 2 (inquiry method) was 4.94 which was significant at 0.05 level of significant in favour of group 1 (individualized instruction). Also, the mean difference between group 1

(individualized group) and group 3 (lecture method) was 11.80 in favour of group 1 (individualized instruction) and this difference was found to be significant at 0.05 level of significance. Significance difference was also found between the mean scores of group 2 and group 3 in favour of group 2 (structured inquiry method). This implies that the mean retention scores of students in the experimental groups (individualised and structured inquiry method) were significantly better than those in the control group (lecture method). However, within the experimental groups, the retention scores of students in group 1 (individualized instruction) is significantly better than group 2 (structured inquiry method). This is evidence in the mean retention scores of individualized, structured inquiry and lecture method groups which are 35.46, 30.52 and 23.66 respectively as presented in Table 2.

Research Hypothesis 2: There is no significant difference in the mean retention scores of male and female students in Physics when taught with individualised instruction, structured inquiry and lecture methods.

Table 3 also shows that the F-value for gender (male and female) is 33.83 with p-value of 0.28 which is greater than 0.05 level of significance, implying that the null hypothesis H_{02} is retained and therefore there is no significant difference in the mean retention scores of male and female students in physics when taught with individualized instruction, structured inquiry and lecture methods.

Discussion of Findings

The finding of mean post-test and mean retention scores of students in the three groups indicated a significant difference between the mean retention scores of the students in the groups. Students taught using individualised instruction performed significantly higher than the other groups. The reason for the finding perhaps could be that students taught using individualised instruction have the opportunity to learn from others and easily understand the lesson. It could also be that students who work with individualised instruction are motivated by being independent and in charge of their own learning no matter how challenging the situation appears to be. This finding agrees with that of Udu (2017) who supported the fact that individualized instruction arouses students' interest since they act independently and learn on their own leading to better understanding and retention.

The findings of this study also indicated that there is a significant difference in the mean retention scores of the students in Physics when taught with structured inquiry and lecture methods in favour of structured inquiry method. This observation may be due to the fact that student taught with structured inquiry method understood the concept taught better due to their active participation in their learning process and thus were able to retain the knowledge longer compare to those taught using lecture method which might be boring to the students due to their little or no involvement in their learning process. This finding concur with Huziak-clark, Van, Hook, Nurnberger-Haag and Ballone-Duran (2007) where it was observed that structured inquiry method is a technique that encourages students to discover or construct

information by themselves instead of a teacher directly revealing the information and hence ensure better retention of the concept learnt.

It was also found from this study that male students retained physics concepts slightly (but not significantly) better than their female counterparts when exposed to individualised instruction, structured inquiry and lecture methods. This could be that the male students easily understand physics concept faster than the female and were able to retain learnt concept longer. This agrees with Inyang and Josiah (2016) who found out that male students achieved slightly higher than their female counterpart and attributed this observed difference to general lack of interest in science by female students.

Conclusion

Based on the findings of the study, it is concluded that individualized instruction and structured inquiry method promotes student's retention in physics significantly better than lecture method. However, individualised instruction was found to enhance retention of learnt concepts by secondary school students better than both structured inquiry and lecture methods. Also, male students retain physics concepts slightly but not significantly better than their female counterparts when exposed to individualized instruction, structured inquiry and lecture methods.

Recommendations

Based on the findings of the study, the following recommendations are made:-

1. Individualised instruction and structured inquiry method should be used by secondary school physics teachers to enhance students' retention in learning physics concepts
2. Physics teachers should use individualised instruction and structured inquiry method to teach both male and female students who will benefit almost equally from the methods.

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