International Research Journal of Human Resources and Social Sciences
ISSN(O): (2349-4085) ISSN(P): (2394-4218)
Impact Factor- 5.414, Volume 5, Issue 4, April 2018
Website- www.aarf.asia, **Email** : editor@aarf.asia , editoraarf@gmail.com

EFFECT OF NORMAN CROWDER'S PROGRAMMED INSTRUCTION MODEL ON UNDERGRADUATES' ACADEMIC ACHIEVEMENT IN DYNAMICS: IMPLICATIONS FOR EFFECTIVE TEACHING AND LEARNING OF MATHEMATICS AND PHYSICS

Dr. Samuel Onyinyechi Nneji
Department of Science and Computer Education, Faculty of Education
Enugu State University of Science and Technology (ESUT) Enugu

Dr. Rose Chigoziri Anamezie
Department of Science and Computer Education, Faculty of Education
Enugu State University of Science and Technology (ESUT) Enugu

Abstract

This study investigated the Effects of Norman Crowder's Programmed Instruction Model on Undergraduate Academic Achievement in Dynamics. The design was a pretest –posttest, nonequivalent control group, quasi-experimental design. Three research questions and three hypotheses guided the study. The study was conducted at Enugu state university of science and technology from where 32 undergraduates made up of 18 mathematics education and 14 physics education students all from science and computer education department were drawn and used as sample for the study. Dynamics Achievement Test (DAT) was used for data collection. DAT was developed by the researchers. It was made up of Thirty (30) multiple choice questions with four options each. DAT was validated by three research experts. Kuder-Richardson's formula 20 (KR-20) was used to determine the reliability test (internal consistency). The reliability coefficient of .63 was obtained for DAT. Research Questions were answered using mean statistics and standard deviation. Test of hypotheses was done using analysis of covariance (ANCOVA) at .05 level of significance. Major findings of the study showed that mathematics education and physics education undergraduates taught dynamics with Norman Crowder's programmed instruction model achieved higher than their counterparts taught the same topics with expository method also the subjects of the study did not differ significantly in their academic achievement based on their gender and area of specialization. It was recommended that Norman Crowder's programmed instruction model be adopted by mathematics and physics lectures in tertiary institutions.

Keywords: Norman Crowder, Programmed Instruction Model, Academic Achievement, Dynamics, Effective, Teaching, Learning, Mathematics, Physics

Introduction

No doubt, one cannot talk of functional education without science. The role of science in the achievement of Nigeria's or any nation's educational objectives and aspirations is, to say the least most vital. Grant (2015) defined science as systematized knowledge in any field. Ricky (2012) stated that science consists essentially of an attempt to understand the relations of selected aspects of things and events in the real world, an attempt which should have both intuitive and logical components, and which must be based on observation and tested by further observation. Parchy (2013) defined science as the systematic study of man and his environment based on the deductions and inferences which can be made, and the general laws which can be formulated from reproducible observations and measurement of events within the universe.

Furthermore, Omenka (2012) defined science as the study of nature. According to Harrison science is an exploration of natural phenomenon. Science seeks to provide a consistent model of the universe. It therefore, explains why and how things happen. Its task is to explain natural events, processes or phenomena. It seeks to disclose universally valid, objective, and verifiable relationships in order to make predictions, and understand causal relationships systems in nature. This means that science is dynamic and scientific facts have predictive power. It portrays a scientist as someone in constant investigation and whose field of investigation is his natural world, he develops some curiosity as to the happenings around him. In a bid to answer the questions that arise; he gains explanation of phenomena. Science is therefore different from other forms of arm chair theorizing and philosophizing.

Tenty (2014) stated that good scientific skills and competences are great assets to students. This is because science is a tool for developing critical and logical thinking that can facilitate the learning of all other subject. It is also a tool for educating the mind. Science gives the individual a fuller understanding of the world around him and this understanding can be applied to solving our day to day problems. Vema (2015) described mathematics as the call of sciences. Vema maintained that mathematics is closely related to all sciences but the closet to mathematics among the core sciences (physics, chemistry and biology) is physics. Zachy (2014) collaborated Samuleson's view claiming that over 70% of physics content is mathematics based. Romanus (2014) described the unity of mathematics and physics as cordial and beneficial to science students. Mathematics and physics, according to Vema, do not only deal with numbers and matter but also with the properties of those numbers and matter in relation with practical human activities. One of the areas the unity of mathematics and physics is illustrated is in the study of mechanics generally and dynamics in particular.

Dynamics is concerned with the study of forces and torques and their effects on motion. In mathematics, dynamics is grouped among applied mathematics. In physics dynamics is grouped under mechanics. Mathematics and physics students in tertiary institutions, be it colleges of education, poly-technics, mono-technics or universities offer courses in dynamics although the courses may differ in course codes and titles. Isaac Newton's laws of motion defined fundamental physical laws which govern dynamics. Dynamics generally involves a study of how a physical system might develop or alter over time as well as the causes of those changes. The study of dynamics falls into two categorizes namely linear and rotational. Linear dynamics according to Wilson (2015) pertains to objects moving in a line and involves such quantities as force, mass/inertia, displacement (in units of distance), velocity (distance per unit time), acceleration (distance per unit of time squared) and momentum (mass times unit of velocity).

Furthermore, Wilson explained that rotational dynamics pertains to objects that are rotating or moving in a curved path and involves such quantities as torque, moment of inertia/rotational inertia, angular displacement (in radians or less often, degrees), angular velocity (radians per unit time), angular acceleration (radians per unit of time squared) and angular momentum (moment of inertia times unit of angular velocity). From the foregoing, it is the clear that good skills and competences in dynamics are veritable tools in the hands of any science students. Unfortunately, research evidences such as Bucky (2015), Tragbala (2015) and Presco (2016) reported that undergraduates do not perform satisfactorily in dynamics.

The researchers cited above and a hand full of other research evidences consistently blamed students' poor academic achievement in dynamics on instructional method and other related factors. Without fear of controversy, one can make bold to say that teaching methods or instructional strategies are indispensible in the quest to elicit maximum and optimal performances from learners. Hence, the search for effective and efficient instructional strategy constitutes great percentage of research concerns among educators in general and science educators in particular. This search has lead to various innovations and creativity in the theory of instructional method. Some of the innovative teaching strategies recommended for effective teaching and learning of sciences at tertiary education level are target task oriented, problem solving, computer-aided instruction, delayed formalization, self-regulated learning, concept mapping, discovery, cooperative learning and programmed instruction.

Programmed instruction according to Ricky (2012) is a method of presenting new subject matters to students in a graded sequence of controlled steps. Learners work through the programmed material by themselves at their own speed and after each step test their comprehension by answering an examination question or filling in a diagram. The learners are then immediately shown the correct answer or given additional information. Computers and other types of teaching machines are often used to present the material, although books may also be used. Tenty (2014) averred that programmed instruction consists of a network of statements and tests, which direct the student to new statements depending on his pattern of errors. It is based on a particular tool which is called teaching machine. There are various origins and flavors of programmed instruction. The most important to subcategories are; linear programs (in the skinner tradition) and branched programs (in the Crowder tradition). This study is focused on branched programmed instruction as propounded by Norman Crowder.

Branching Sequences/Branching Programming

The founder of Branching programming is Norman Crowder, hence it is also known as Crowderian Model. It is based on conjuration theory of learning. It is a problem solving approach. It is stimulus centered approach of learning. As the word branching means the subdivision the stem or trunk. The same concept is applied in the branched programming instruction style. The main concept (the trunk of the tree) is sub divided into smaller concepts (the stems of the tree) and further again to other minute details of the topic. Norman Crowder has given its definition as ―It is a programme which adapts to the needs of the students without the medium of extrinsic device as a computer. It is called intrinsic because the learner within himself makes the decision, to adapt the Learning to his/her needs. The rationale of intrinsic programming postulates that the basic learning takes place during the student‘s exposure to the new material on each page. In branching programme, the learning material is divided into units of material called "frames‘. Much information, one or two paragraphs or even a page, is provided in a frame.

Thus each frame is quite larger than that employed in linear programme. The learner goes through the frame. After that he is required to respond to multiple choice questions associate with the learning material of the frame. The learner moves forward if he answers correctly but is diverted (branched) to one or more remedial frames if he does not. These frames explain the matter afresh, ask him questions to elicit the right answer and reveal his previous mistakes, and then return him to original frame. This cycle goes on till the learner passes through the whole instructional material at his own pace. Each Content frame includes the following: Repeating student response; Positive commotion; New information; Question and Alternatives followed by page numbers, where the student should go next. Each Remedial frame includes the following: Repeating student response; Negative commotion; Reasons why he is wrong; Further explanation in simple language and Directions as to where the student should go next.

Features of Branching programme

The features of branching programme include:

1) Material in a frame is larger; much information is presented at each step. A step may consist of two or more paragraphs and sometimes a full page.

2) The method of student response is different than that of linear model; student has to make choice out of several choices. Multiple-choice question are asked. Each response to the question is keyed to different pages. If the learner selects correct response, his response is confirmed and in case he selects wrong response, then he routed to material which explains as to why he is wrong.

3) Crowder holds that teaching is communication and so he concentrates his attention upon the improvement of communication.

4) Learner has freedom to choose his own path of action according to the background of subject matter. The learner controls the exact sequence that he will follow.

5) The programmer has sample opportunity to exploit the literary style.

6) Student is more alert and concentrates on the subject matter more carefully.

7) Detection and concentration of errors is important. Crowder holds that making error is basic to learning. He permits 20 percent errors in his model. In such a model the errors are detected and then corrected. The learner knows why he is wrong. Crowder says that it is impractical to eliminate errors in the process of learning the crucial and identifying feature of branching model is the fact that the material presented to each student is continuously and directly controlled by the learner‘s performance in answering questions.

8) Intrinsic programmed material when presented in a book form, the book is called scrambled book because the pages do not follow in a normal sequence.

9) It is very useful to concept learning or where the material is given larger steps.

10) The role of active response is not central in intrinsic theory. Intrinsic programme less guidance to learner as to what material in the frame is important.

As effective as Norman Crowder programmed instruction model may sound in enhancing students' academic achievement, research evidences have reported conflicting findings on its efficacy with regard to mathematics and physics. While Bucky (2015) and Barley (2016) found that this teaching model promoted students' academic achievement. Grant (2015) and Presco (2016) found the contrary. Also Zachy (2014) and Vema (2015) found that male undergraduates achieved higher than their female counterparts in a programmed instruction class while Omenka (2012) and Romanus (2014) reported that female undergraduates outperformed their male counterparts when taught the same content with program instruction model. This gap of no definitive conclusion justifies the need for more studies such as this present work.

Statement of the Problem

The role of science in general and mathematics and physics in particular in achieving the functional education required for the attainment of the Nigerian national objectives cannot be over-emphasized. The unity of mathematics and physics has been described as mutual and beneficial. One of the concepts studied both in mathematics and physics at tertiary education levels is dynamics. Mathematics and physics educators have consistently portrayed dynamics as a very important concept. The study of dynamics can equip the science undergraduates' with basic competences and skills to excel even in other topics and courses. Regrettably, undergraduates' achievement in dynamics is yet to hit the satisfactory level. Research evidences have consistently implicated teaching method as a major factor causing this menace.

Of all the innovative instructional strategies, programmed instruction, especially Norman Crowder's model has been widely recommended, yet there is still no definitive conclusion as to its effect on students' achievement in mathematics and physics. More worrisome, also is the no definitive conclusion on the influence of Norman Crowder's programmed instruction model on academic achievement of male and female undergraduates. This study therefore was a deliberate attempt to bridge the gap highlighted above.

Purpose of the Study

The purpose of this study was to investigate the Effects of Norman Crowder's Programmed Instruction Model on Undergraduate Academic Achievement in Dynamics.

Specifically, the study aimed at investigating the effects of Norman Crowder's Programmed Instruction Model on undergraduates;

- **I.** Achievement in Dynamics
- **II.** Achievement in Dynamics with regard to gender (male and female)
- **III.** Achievement in Dynamics with regard to students' area of specialization (mathematics education and physics education).

Research Questions

The following research questions guided the study

1. What are the mean dynamics achievement scores of the students in both experimental (those taught with Norman Crowder's Programmed Instruction Model) and control (those taught with expository method) in pretest and posttest?
2. What are the mean dynamics achievement scores of male and female undergraduates in the experiment?
3. What are the mean dynamics achievement scores of mathematics education and physics education students in the experiment?

Hypotheses

The following research hypotheses were tested at .05 level of significance

1. There is no significant difference between the mean dynamics achievement scores of students in the experimental and control groups.
2. There is no significant difference between the mean dynamics achievement scores of male and female students in the experiment.
3. There is no significant difference between the mean dynamics achievement scores of mathematics education and the physics education students in the experiment.

Methodology

Research Design

The research design adopted in the conduct of this investigation was quasi-experimental design. Specifically the design was a pretest –posttest, non-equivalent control group design. This study was conducted at Enugu state university of science and technology from where 32 undergraduates made up of 18 mathematics education and 14 physics education students all from science and computer education department were drawn and used as sample for the study. The sample was also made up of 23 female and 9 male students.

Dynamics Achievement Test (DAT) was used for data collection. DAT was developed by the researchers. It was made up of Thirty (30) multiple choice questions with four options each. The DAT was drawn using table of specification to ensure adequate coverage of the content areas covered in the study, hence the content validity. DAT was validated by three research experts. After necessary corrections as directed by the experts, it was confirmed to be valid and suitable for the study. Since the items of DAT are dichotomously scored, Kuder-Richardson's formula 20 (KR-20) was used to determine the reliability test (internal consistency). The reliability coefficient of .63 was obtained for DAT.

Experimental Procedures

At the beginning of the experiment, DAT was administered to all the subjects of the study as pretest. Thereafter, the treatment was administered for a period of five weeks. The experimental group was taught the selected topics in dynamics using Norman Crowder's Programmed Instruction Model while the control group was taught the same topics using expository method. At the expiration of the treatment period, the DAT was re-arranged and administered to all the subjects as posttest. Research Questions were answered using mean statistics and standard deviation. Test of hypotheses was done using analysis of covariance (ANCOVA) at .05 level of significance.

Results

Research Question One

What are the mean dynamics achievement scores of the students in both experimental (those taught with Norman Crowder's Programmed Instruction Model) and control (those taught with expository method) in pretest and posttest?

Table 1: Pretest and Posttest mean dynamics achievement scores of the experimental and control groups

Group	n	Pretest Mean	Standard Deviation	Posttest Mean	Standard Deviation
Experimental	16	38.9	11.0	69.5	4.1
Control	16	40.0	11.1	44.2	8.8

From table 1, the pretest mean dynamics achievement score and standard deviation of the experimental group were 38.9 and 11.0 respectively while those of the control group were 40.0 and 11.1 respectively. However, the posttest mean dynamics achievement scores and standard deviation were 69.5 and 4.1 respectively for experimental group while 44.2 and 8.8 were those of control group. Apparently both groups scored poorly in the pretest and the standard deviations of 11.0 and 11.1 for both groups were high showing that there were more extreme values; only a few scores clustered around the mean, therefore the mean scores for both groups in the pretest were not very reliable.

However, in the posttest, experimental group achieved higher with a mean of 69.5 and lower standard deviation of 4.1 unlike the control group which achieved lower with a mean of 44.2 and a higher standard deviation value of 8.8. Comparing with the pretest data, learning took place in both groups but better in experimental group. Also the mean score for experimental group was more reliable than that of control group as revealed by the standard deviation values of both groups. There were more extreme scores in the control group.

Research Question Two

What are the mean dynamics achievement scores of male and female undergraduates in the experiment?

Table 2: Mean Achievement scores of male and female students in pretest and posttest.

Group	N	Pretest		Posttest	
		Mean	SD	Mean	SD
Male (Experimental)	5	39.1	10.8	67.8	5.5
Female (Experimental)	11	38.0	10.9	68.2	4.0
Male (Control)	4	39.8	10.8	42.9	9.0
Female (Control)	12	39.9	11.0	43.4	8.2

From table 2 above the posttest mean score of the male (Experimental) was 67.8 while that of female (Experimental) was 68.2. Similarly, the posttest mean score of the male (control) was 42.9 while that of female (Control) was 43.4. This result suggests that both experimental groups (male and female) achieved equally and both control groups (male and female) achieved equally.

Research Question Three

What are the mean dynamics achievement scores of mathematics education and physics education students in the experiment?

Table 3: Mean Achievement scores of mathematics education and physics education students in pretest and posttest.

Group	N	Pretest		Posttest	
		Mean	SD	Mean	SD
Mathematics (Experimental)	9	38.5	9.9	69.0	3.7
Physics (Experimental)	7	39.0	11.1	68.9	3.9
Mathematics (Control)	9	40.2	11.0	43.6	8.1
Physics (Control)	7	38.4	10.2	44.0	8.9

From table 3 above the posttest mean score of the mathematics education (Experimental) was 69.0 while that of physics education (Experimental) was 68.9. Similarly, the posttest means score of the mathematics education (control) was 43.6 while that of physics education (Control) was 44.0. This result suggests that both experimental groups (mathematics and physics students) as well as control groups (mathematics and physics) did not differ significantly in their academic achievement in the study.

Hypothesis 1: There is no significant difference between the mean dynamics achievement scores of students in the experimental and control groups.

Hypothesis 2: There is no significant difference between the mean dynamics achievement scores of male and female students in the experiment.

Hypothesis 3: There is no significant difference between the mean dynamics achievement scores of mathematics education and the physics education students in the experiment.

Table 4: ANCOVA analyses of the students' mean mathematics achievement scores.

Source	Sum of Squares	DF	Mean Square	F	Sig.	Decision
Method	880.004	1	880.004	19.588	0.001	Sig (reject)
Gender	71.333	1	71.333	1.587	3.209	Not sig (do not reject)
Method*Gender	60.009	1	60.009	1.335	2.222	Not sig (do not reject)
Specialization	69.2001	1	69.2001	1.540	3.001	Not sig (do not reject)
Method*Specialization	58.404	1	58.404	1.300	3.400	Not sig (do not reject)
Error	1213.000	27	44.925			
Total	2351.9501	32				

From table 4, instructional method (programmed instruction/expository) as main effect gave an f value of 19.588 and this is significant at .001. Since .001 is less than .05 this means that at .05 level of significance, the f value of 19.588 is significant. Therefore, hypothesis 1 is rejected as stated. This indicates that there is a significant difference between the mean achievement scores of the experimental and control groups in favour of the experimental group who were taught dynamics with Norman Crowder's programmed instruction model.

Students' gender (male/female) as main effect gave an f value of 1.587 and this is significant at 3.209. Since 3.209 is greater than .05, this means that at .05 level of significance, the f value 1.587 is not significant. Therefore, hypothesis 2 is not rejected as stated. This indicates that there is no significant difference between the mean dynamics achievement scores of male and female students in the experiment. This result is further validated by the test for interaction effect between method and gender which is not significant.

In the same vein, students' area of specialization (mathematics education/physics education) as main effect gave an f value of 1.540 and this is significant at 3.001. Since 3.001 is greater than .05, this means that at .05 level of significance, the f value 1.540 is not significant. Therefore, hypothesis 3 is not rejected as stated. This indicates that there is no significant difference between the mean dynamics achievement scores of mathematics education and the physics education students in the experiment.

Interaction effect between (method*specialization) proved insignificant. Hence, collaborating this result.

Summary of findings

Findings made in this study can be summarized thus

1. Mathematics education and physics education undergraduates taught dynamics with Norman Crowder's programmed instruction model achieved higher than their counterparts taught the same topics with expository method.
2. Male and female mathematics education and physics education undergraduates with Norman Crowder's programmed instruction model did not differ significantly in their academic achievement.
3. Mathematics education and physics education students taught dynamics with Norman Crowder's programmed instruction model achieved equally.

Implications for Effective Teaching and Learning of Mathematics and Physics

The findings of this study have serious implications for effective teaching and learning of mathematics and physics. Formost, the findings have shown that teaching methods or methodology is very important in the educational system. According to Parchy (2013) methodology is the analysis of the principles of methods, rules and postulates employed by a discipline or the systematic study of methods that are, can be, or have been applied within a discipline. Methodology, hence, includes a philosophically coherent collection of theories, concepts or ideas as they relate to a particular discipline or field of inquiry. Obviously, methodology refers to the rationale and the philosophical assumptions that underlie a particular study relative to the scientific method. Grant (2015) defined methodology as the study of the methods of teaching or the study and practice of various methods of teaching. This implies that methodology is both the study of different methods and the systematic means of presenting subject matter and learning experiences. Many of the methods of teaching have their origins in the various theories of learning. The study of methodology covers not only the philosophy of methods but also the influence of psychological principles involved in learning.

Ricky (2012) posited that early attempts to develop a methodological foundation of mathematics and physics attempted to vindicate them as disciplines free of error that did justice to their arrogant and secular epithets as the most perfect of all sciences. Vincent (2014) argued that if mathematics and physics are, as the Platonist tradition suggested, just an entity out there waiting to be discovered, then it will be enough for schools to present the curriculum instruction as a mere collection of facts, definitions and algorithms. In that regard, teaching mathematics and physics would be like just transmitting an immutable body of knowledge that students have to accept as a perennial fact without any reasoning. However, if mathematics and physics are empirical activities, then learners are in the position of constructing their own mathematics and physics knowledge regardless, of how different their methodology may be from cannon of orthodox and classical science, (Nneji, 2017). This later view forms the basis of this study.

From the findings of this study, mathematics and physics educators should bear in mind that it is often possible for learner's to learn the 'how' (that is procedures) mechanically without understanding 'why' it works (that is conceptual knowledge). Procedures learnt this way are often forgotten easily. Conceptual and procedural understanding actually helps each other. Conceptual knowledge is important for the development of procedural fluency. While fluent procedural knowledge, supports the development of further conceptual understanding. The findings of this study show that Norman Crowder's programmed instruction model can facilitate both conceptual and procedural understanding when properly utilized.

To programmed instruction designers, the findings of this study and the conflicting results of reviewed empirical studies imply that well designed programmed instruction models have the potentials to promote students' achievement in mathematics and physics. Hence, designers should bear in mind that the arousal features of programmed instruction models need not overshadow the intended lessons. The play and amusement features of programmed instruction models should elicit both emotional and cognitive interest of learners. Seductive details should be eliminated. Programmed instruction models should be designed as simple as possible. Hence, with minimum computer literacy or proficiency, a mathematics and physics teacher can use it to teach profitably.

Furthermore, the findings of this study imply that students taught mathematics and physics with programmed instruction models can achieve very well regardless of their gender and area of specialization. The findings of this study have serious implications to the student. This is because the programmed instruction model, as a constructivist process, is a student-centered model. In student-centered models, generally, the students are in charge. The teacher offers minimal guides and allows the students to construct their own understanding by seeing relationships between incoming information and their previous knowledge. Students thus, determine their own knowledge based on their own way of processing information and according to his or her own beliefs and attitudes towards learning. From the foregoing, students taught mathematics and physic with programmed instruction model are expected to develop skills for indepth analysis of any given problem. These skills will enable them think reflectively, creatively and productively. Since programmed instruction model is student-centered, it implies that if the process fails, students should bear commensurate blames.

Recommendations

Consequent upon the findings of this study, the following recommendations are made;

1. Norman Crowder's Programmed Instruction Model should be used in teaching mathematics and physics in tertiary institutions.

2. Mathematics and physics lecturers should be trained through intensive seminars, workshops and in-service trainings on the use of Norman Crowder's Programmed Instruction Model.

Conclusions

Based on the findings of this study, the following conclusions were made;

1. Norman Crowder's Programmed Instruction Model enhances undergraduates' achievement in mathematics and physics.
2. Norman Crowder's Programmed Instruction Model affects male and female students' achievement in dynamics equally.
3. Norman Crowder's Programmed Instruction Model affects mathematics education and physics education students' achievement in dynamics equally.

References

Barley, P. (2016). Effect of Programmed Instruction Model on 5th grade pupils' achievement in physics. *http://www.African quarters.org/journal 5(2). 230- 241. Retrieved 05/11/2015.*

Bucky, P.N (2015). Validating High school basic sciences. Eds science journal (4), 502-516. www.edsjournal.com

Grant H. (2015) Efficacy of Programmed Instruction in promoting creative and critical thinking among secondary school students. *www.edu support.net/newsletter. 448010322/ ABSTRACT. Retrieved 08/05/2016.*

Nneji, S.A. (2017). Effect of Delayed Formalization Strategy on Secondary School Students' Achievement and Retention in Algebra in Enugu state. *Benue State University Journal of Education.*

Omenka, A. M. (2012). Effect of Self Programmed Instruction on students' achievement in mathematics in Public and private secondary schools. www.mathscorner/tcl.com. Retrieved 08/05/2016.

Parchy, W.J. (2013) Effects of Programmed Instruction on students' achievement and Learning in mathematics. *Journal of Technology Education 14 (2) 101-222* http://www.scholar/ib.vt. edui/ ejour/ijev/1472/haynie/. html Retrieved 02/02/2015.

Presco, P.A. (2016) Effect of Programmed Instruction on students; achievement in physics. *www.artscorner/tcl.com. Retrieved 08/05/2016.*

Ricky, S.K. (2012) Enhancing Achievement of students in physics through Programmed Instruction. *http://www.artscorner.prg.com./journal 12(1). 118-129. Retrieved 04/05/2016.*

Romanus, J. B. (2014). The effect of Programmed Instruction. *Journal of social sciences Learning 23(1) 260 – 270.* New York: Blackwell Publishing Ltd.

Tenty, P.Q. (2014) Percentage coverage of the stated behavioural objectives for basic sciences in Eastern Canada. http://www.jer.infotex/vol6.com. Retrieved 6/8/15.

Tragbala, H. (2015) Efficacy of Programmed Instruction in promoting creative and critical thinking among secondary school students. *www.edu support.net/newsletter. 448010322/ ABSTRACT. Retrieved 08/05/2016.*

Vema, A. M. (2015). Effect of Programmed Instruction on students' achievement in mathematics in Public and private secondary schools. www.mathscorner/tcl.com. Retrieved 08/05/2016.

Vincent, W.J. (2014) Effects of Programmed Instruction on students' achievement and Learning in mathematics. *Journal of Technology Education 14 (2) 101-222* http://www.scholar/ib.vt. edui/ ejour/ijev/1472/haynie/. html Retrieved 02/02/2015.

Wilson, P.N (2015). Validating High school basic sciences. Eds science journal 0(4), 502-516. www.edsjournal.com

Zachy, S.K. (2014) Enhancing Achievement of students in physics through Programmed Instruction. *http://www.artscorner.prg.com./journal 12(1) 118-129. Retrieved 04/05 2016.*