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Assessment of Practical Competency Improvement Needs of Physics Teachers in Public and Private Secondary Schools in Abia State, Nigeria

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Abstract

This study was designed to assess the practical competency improvement needs of physics teachers in public and private secondary schools in Abia State, Nigeria. Survey research design was adopted for the study. The instrument for the study is the researcher-developed Practical Competency Improvement Needs Questionnaire – PCINQ (Cronbach Alpha Coefficient = 0.92). The PCINQ was administered to a sample of 64 Physics Teachers drawn from the Public and Private Secondary Schools in Abia State. Four research questions guided the study and four hypotheses were tested. Mean and standard deviation were used to answer research questions while t-test was used in testing the hypotheses at 0.05 level of significance. In-depth analysis of data obtained in the study revealed that there is a need for improvement in the competency required in planning practical (cluster mean attitude score

= 2.85), organizing practical (cluster mean attitude score = 2.87) laboratory management (cluster mean attitude score = 2.92) and evaluation of practical (cluster mean attitude score = 2.87) of physics teachers in public and private secondary schools in Abia State. The t-test analysis of practical competency improvement need index established no statistically significant difference between the competency required in planning, organizing, laboratory management and evaluation of practical between public and private secondary schools in Abia State. Based on the findings of the study, it was recommended that physics teachers should seek for higher learning and qualifications by continuously leveraging on several teachers re-training programs to improve their competencies in teaching. Stakeholders in education should ensure that only qualified teachers are employed to teach in our secondary schools.

Keywords: Physics, Physics Education, Physics Practical, Physics Practical Competency, Physics Practical Competency Improvement Needs, Physics Teachers

Introduction

Nations, generally, have accepted science education as key to their technological development, it is known as the foundation upon which the bulk of present day technological breakthrough is based on, (Onasanya & Omosewo, 2011). Science comprises such basic disciplines as physics, Mathematics, Biology, Chemistry and Physics (Oladejo, Olosunde, Ojebisi and Isola, 2011); all this subjects are taught at the senior secondary school levels. The impact of science is felt in every aspect of human endeavor so much that it is intricately linked with a nation's development. Thus from the standpoint of the society, the most urgent aim of education is to facilitate social and economic development of the society (Cassady, 2014).

This was evident in the United States of America in the 1960s shortly after the technological feat of the Sputnik episode. The Americans took immediate steps to revolutionize their science education program in schools. A new school science curriculum was developed, namely, the Biological Sciences Curriculum Study (BSCS – Yellow and Blue versions), the Chemical Education Material Study (CHEM Study), the Physical Science Study Committee (PSSC) course; which explored the new methods of teaching sciences (e.g. the discovery method – with its different facets and applications). These actions accounted substantially for the sound technological advancement of the USA and the technological height the nation has attained today. Other developed nations followed the same pattern, refocusing their science education program – in terms of content, delivery and relevance and they have similar results.

According to Upinder Dhar and Gyanamamritum, 2014, Education is seen as a conscious effort of a nation to inculcate her existing body of knowledge, values, norms, science and technology and way of life into the young generation for the purpose of active participation and development of the nation. Thus, the true meaning of education is harmonious development of head, heart and hand i.e., enlightenment of the mind, compassion and dignity of labor. To achieve this purpose, the society engages the services of educational personnel and institutions where children are taken through well-planned structures. As such, education is expected to expose learners to the scientific and analytical thinking competencies they need to understand, build and create new technologies. The

quest for technological development critical for economic development, must equally be propelled by effective science education programs of which the learning and teaching of physics is integral and fundamental.

The world summit on sustainable development (2002) as reported in Akporehwe and Onwiodukit (2013) confirmed the role of science and technology education as a panacea for sustainable development of any nation. Government in acknowledging the strategic role science plays in national development has directed Nigerian Universities to formulate policies geared towards admitting candidates on a 60:40 ratio in favor of science courses. But over the years, students' performance in physics in secondary school certificate examination has remained poor and not only is the performance poor, students' enrolment in physics do not attain 40% of total enrolment in secondary school certificate examination at each given year. The negative impact of this is that students' intake into higher institutions to study key science courses has not attained this recommended ratio of 60:40 in the admission policy (Nnaka & Anaekwe, 2011), this was also recommended in the National Policy on Education for technology-based institutions (Federal Republic of Nigeria – FRN, 2015).

The concomitant frustration this brings is not only on the students but also on Nigeria as a nation who's Policy on Education provision on admissions between science and non-science courses has not been attained and may not likely be attained except these inhibiting factors are quickly resolved, and this is capable of bringing frustrations and set back on our efforts towards our socio economic development. Nigerian youths with aptitude for science cannot actualize their dreams; our oil and gas sector remains largely managed by foreign personnel; joblessness, poverty and deprivation fuels anger, bitterness and hopelessness among the youth which snowballs into conflicts and agitations. These can be minimized or possibly avoided if we can get our science education well at all levels. Many factors were identified as responsible for the poor performance of students in physics in secondary schools which includes: poorly equipped laboratories, lack of qualified and competent teachers, curriculum overload, poor attitude of students and gender biases as reported by (Effiong, 2002).

Physics is the study of matter in relation to energy in space and time. The study of physics is very critical in science education programs. According to the United Nations Education Scientific and Cultural Organization, UNESCO (2012), physics education that is relevant and of quality can develop critical and creative thinking, assist learners to suss and participate in public policy discussions, encourage behavioral changes that can put the world on a more sustainable route and stimulate socio-economic development. The knowledge of physics finds application in all other scientific and non-scientific subjects in varying degrees. Students' performance and achievement in physics especially at SSCE level is fundamental for further studies in scientific and technological disciplines in tertiary institutions. This accounts for the efforts towards ensuring that the teaching and learning of physics in schools is effective and efficient Jegede & Adedajo (2013) believe that physics education is key and major in enhancing technological development. The objectives of studying physics in our schools as contained in the national education scheme designed for secondary school physics (1985) include among others, to provide basic literacy in physics for active living in

the society and to acquire essential and requisite scientific competencies, attitudes, norms and values as a preparation for the technological application of physics. Thus, physics as a science subject is activity based and practical-oriented or hands on and the suitable methods of teaching it, is resource based. This suggests that the mastery of physics and its concepts can only be fully achieved with the use of efficient, effective and a competent personnel / teacher.

Currently physics being of the physical science and taught in secondary schools is taught both in theory and practical, in external and internal examinations; practical physics is examined separately as an integral part of the subject. Physics lessons which takes place in laboratories where both students and teachers carry out experiments and practical demonstration differentiates it from other non-science subjects in school curriculum. This approach of learning and teaching of physics makes it practical oriented. Practical is encouraged in science subjects (physics especially) since it facilitates the learning and understanding of science concepts, and in the development of competencies and procedures of scientific attitude. Practical activities in sciences provides Students with opportunities design and carryout experiments, make observations, select observations relevant to their investigations for further study, seek, identify patterns and evaluate explanations to those patterns, thus, physics practical is an important component of physics education.

Practical encourages accurate observation and painstaking recording; Promoting simple common sense in scientific methods of thought; Developing manipulative skills; Giving training in problem-solving; Fitting the requirements of practical examination regulations; Elucidating the theoretical work so as to aid comprehension; Verifying facts and principles already taught; finding facts by investigation and arriving at principles; Arousing and maintaining interest in the subject; Making natural phenomenon more real through actual experience.

Specifically, Trowbridge and Bybee (1990) identified what should constitute the objectives of practical work in physics to include: Developing skills in problem-solving through identification of problems, collection and interpretation of data, and drawing conclusions; Develop skills in manipulating laboratory apparatus; Establishing systematic habits of record keeping; Developing scientific attitudes; Learning (*and applying*) scientific methods of solving problems; Developing self-reliance and undependability; Discovering unexplored avenues of interest and investigation; Promoting enthusiasm for the study of science.

Studies have shown that students' participation in science practical work contributes significantly to their understanding of the concepts taught (Millar, 2009) and learning of science process skills and attitudes (Johnstone & Al-Shuaili, 2001). Hence, practical work occupies prominent place in science education program and has generated strong interest and research (Hodson, 1991; Osborne, 1998; Millar, 2009).

Physics practical offers students' opportunity to learn by doing and to do "what scientists do" (Ajeyalemi, 2011). Unfortunately, this aspect of teaching and learning physics is often ignored by teachers. Often as a result of ill-equipped laboratory. (Agbola & Oloyede, 2007), teacher incompetence (Adesoji & Arowosegbe, (2004) and lack of time (Akpan,

1999). Given the importance of practical work in physics to the overall development of knowledge and skills of the physics students in secondary schools, it has become pertinent to explore how teachers could be properly retooled and repositioned on how to guide students effectively in practical physics.

In recent times, sudden increase has been witnessed in the establishment of private secondary schools due to the liberalization policy of the federal government, most parents are of the opinion that the standard of education in private secondary schools is better than that in the public secondary schools regarding achievement, Ekundayo (2013) reported that performance is mostly affected by a number of statistical indicators including the student-staff ratio, qualification of teachers, years of experience of teachers and the nature-nurture factors etc.

Unfortunately, teaching and learning of physics in secondary schools has been observed to have some flaws that include: Using the lecture method which is teacher centered to teach physics, concentrating on the usage of textbooks and not exploring other teaching materials, Laying more emphasis on the mathematical computations than the physics concepts, learning process is confined to reading and memorization, critical and creative skills are rarely developed. (Agommoh, 2015).

According to Nwanekezi and Ifionu (2010),

> Teaching is one occupation that has the greatest number of quack despite its position as the "key" for development of human intellect. From pre-nursery level, it is common to find people who do not have teaching qualifications still parade themselves as professional teachers. It is no doubt that even the teacher education institutions which are expected to turn out teachers who are intellectually, socially and professionally competent end-up producing half-baked.

Although adequate strategies have been put in place for the implementation of the policies a closer look on of the implementation process reveals that the objective are not being realized (Ivowi, 2000). An indepth analysis of the implementation strategies of the national policy is properly documented in Ivowi (2000), and it shows a mismatch and disagreement between policy and its implementation. For instance, while the government wants majority of students to do sciences in schools, most schools have no laboratories at all. Apart from poor provisions in terms of facilities, the problem was compounded by the huge population in schools dated as far back as 1970's (Ivowi, 2000). Based on these major landmarks, the emphasis of science education in this twenty-first century should be on quality assurance for science students, science teachers and Nigerian society as a whole.

Obioma (2009) capped it saying that:

> Physics is crucial for effective living in this modern age of science and technology. Given the application of physics in industry and many other professions, it is imperative that every student is given an opportunity to acquire some of its concepts, principles and competencies. Unfortunately, the teaching and learning of physics has experienced

> challenges which prevent many students from performing well in external examinations. The philosophy, objectives and concepts of physics curriculum have been adjudged by experts in the field to be satisfactory; but its implementation has fallen short of expectation because of insufficient number of competent teachers, inadequate laboratory equipments to ensure the performance of related-students activities which are aimed at enhancing meaningful learning.

From the afore-going, it can be seen that rather than achieving the general objectives of senior secondary physics curriculum, physics education at the secondary school level seems to need refocusing.

The West African Examination Council (WAEC) utilizes practical test/examination to assess students' acquisition of various physics practical competencies. In these tests, students are required to carry out certain physics practical activities following some laid down rules and guidelines, the scores of the students obtained through the marking of their practical directly and indirectly indicate the level of physics practical process skills they acquired an can demonstrate during actual practical examinations. This method of assessment is also adopted by physics teachers who prepare students for SSCE. The method of assessment influences the teaching strategy adopted by teachers. Also student's learning styles and characteristics are influenced such that they always try to find out most appropriate responses or answers irrespective of the procedures followed.

This reason has made the WAEC and bodies that conduct SSCE to stipulate that practical activities should form the basis of teaching. During examination, practical work is also examined separately and theory separately.

To achieve this and more, a competency focused study that is qualitative in approach, objective and methodology is indeed timely and required. West African Examination Council (WAEC 2015) through their chief examiners report for the last five years observed the following candidate's weaknesses in examinations: Disregard to instructions e.g. plotting of certain graphs to start from origin (0, 0). Inconsistencies in number of decimal places (d.p) and significant figures (s.f); Inability to make correct deductions from graphs e.g., significance of the slope; Poor computational skills; Inability to adhere strictly to the rubrics; Inability to record measured data to the required degree of accuracy; Poor responses to the questions on the theories of the experiments; Inability to interpret and understand the demands of each questions.

To remedy these weaknesses, it was suggested that Practical items should be provided adequately and timely; Candidates should engage in a lot of laboratory work before their final examination; Schools should endeavor to engage Physics graduates to teach Physics in their schools; and that teachers should be encouraged to attend workshops and coordination meetings to improve and acquire more skills (WAEC Chief Examiners Report 2015, 2017).

Continuing, it was also observed that in addition candidate's weaknesses included: Poor manipulation of arithmetic processes; Inability to convert SI units correctly e.g. length

in feet or millimeters to meters; area in centimeter squared to m2, etc.; Inadequate grasp of basic concepts in physics; Inability to interpret drawings and graphical representation of physical quantities; Inability to relate acquired knowledge to real life situations; Failure distinguish between static and kinetic friction; Inability to give acceptable description of laboratory experiment; incomplete rendering of laws and definitions; Not realizing that diagrams are as important as its explanations; Difficulty in solving problems Standard forms; Inability to differentiate between objects undergoing a certain type of motions and when these objects are actually in motion; Language problem hence they could not understand the demands of some questions nor were they able to express themselves clearly.

The following remedies were suggested: Motivating both students and teachers; Ensuring availability of teaching and learning materials in schools; Students to expend their horizons studying every aspect of the syllabus; Teachers to emphasis the understanding of basic principles of physics; Teachers stressing salient points in the definition of terms, theories and law; WAEC to derecognize schools without qualified teachers and well equipped laboratory; Teachers should endeavor to attend coordination meetings so as to know areas of competencies they need to improve on, Government /private schools to recruit qualified physics teachers (WAEC Chief Examiners Report 2015, 2016, 2017).

The practical component of the report shows that for it to be achieved, the physics teacher should be competent in teaching and Sequel to the report, there is every need therefore, to assess the competency improvement needs of secondary school physics teachers for effective practical teaching in Abia State of Nigeria and wherever such is contemplated.

Statement of the Problem

Students' performance in physics is the aggregate of their performances in theory and practical works in the subject. Consistently, Chief Examiners' Reports state that the continuing decline in performance of students in the SSCE in physics may be traceable more to their poor acquisition of relevant science skills and consequent poor performance of students in the practical aspect of physics examination. With the observed poor preparation of students for science practical (Agbo & Mankilik, 1999; Akpan, 1999; Maskill, 2000), students tend to perform poorly in science practical which leads to overall poor performance in the science subjects. Students after graduation from secondary school barely conduct practical work in physics, nor set up a practical physics-based enterprise. Perhaps, the causes of students' poor performance and non-application of practical physics may be attributed to the level of competency possessed by the teachers. The performance of Physics teachers in our public and private secondary schools has long been a concern among science educators, parents, stakeholders and policy makers. This worry is as result of the poor performance of students in practical Physic examinations at the senior secondary school level.

Teacher's incompetency is a factor that could easily deter teachers from engaging in the meaningful task of teaching practical lessons. According to National Policy on Education (FRN, 2015), teacher education will continue to be given more emphasis in all education planning since no education system can rise above its teachers. Teachers are prime movers in development and people interested in the progress of any nation should think more

seriously about teacher education programs. A situation where a physics teacher pays "lip service" to activity-oriented instructional methods and resources that could enhance creative thinking in the learners negates the objectives of physics education at the secondary school level. The need to fashion out competency improvement areas of physics teachers in order to provide students with practical experiences in leaning physics is the thrust of this research work.

It is appropriate to identify the practical competency improvement needs of physics teachers so that workshops and programs can be packaged to improve their competencies so as to guide students in practical work. There is therefore the need to assess the practical competency improvement needs of secondary school physics teachers in Abia State of Nigeria.

Literature Review

Conceptual Frame Work

Philosophy of Physics Curriculum in Nigeria

The major concepts which unify the topics in the senior secondary school physics curriculum are motion and energy. The relevance of the physics topics to society in terms of application is stressed throughout in the curriculum and only the topics which are directly derivable from the concepts and their sub concepts were selected. The approach in the curriculum generally is to treat the topics under a unifying concept and provide some elaboration in the applications in order to advocate usefulness and application of copious illustrations to aid understanding. In addition of such attempt at functionality, a specific teaching approach was advocated: Practical (The guided discovery method of teaching) has been recommended and is aimed at ensuring that learning, as an activity takes place while the student's mind is engaged actively through series of a well – structured and planned experiences. These are typified with discussions, experimentation and questioning.

The teacher prepares his lesson properly through careful planning, organization, laboratory management, evaluation and guides students very well so that learning takes place. Here, teaching should not be emphasized at the expense of learning, thus the lecture method, which is effective and efficient for covering lots of ground quickly is not recommended. This was to avoid a rigid one way traffic in the laboratory or classroom but rather to put in place a real interaction between students, teachers and equipment. The merits of the guided-discovery method was discussed (Ivowi 1984). Similar to other science programmes, three factors have been emphasized in the secondary school physics curriculum content. These are understanding of concepts, functionality and application. Ability to explain concepts and principles, and apply them in given situations is needed in physics because of the crucial role it plays in the development of science and technology of any nation. Functionality entails the use of functional instructional materials to expose students to the various processes and to enable them to acquire relevant competency. A high level of accuracy is not actually crucial at this stage; but complete dependence on the precision of the instrument used and the teacher's mastery in teaching needs to be stressed. The final effect of application and functionality is to enhance understanding of the concepts being taught (Ivowi 1990). Given the nature of physics and paucity of teachers

(incompetency of teachers) and equipment in schools, it is difficult to effectively implement the provisions of the SSS physics curriculum. This has resulted in a difference between the prescribed programme and what is actually implemented in the schools (Oludotun 1981, as cited in Adeyemo 2010.)

Essential Features of Physics Curriculum in Nigeria

In Nigeria, Physics, has been found to be the bedrock of scientific and technological development both in under-developed and developed nations alike, it has some features which are generally accepted and believed to widen the horizon of understanding of physics by the learners. These features are made essential because it is believed that if they are adhered to in any given situation at any given period of time will be able to make this subject easy to understand by learners and as a result nullify the misconceptions of people, students, teachers, parents and community at large about physics.

Some of these features are:

i. Guided discovery method should be the method of teaching instead of the old and routine lecture method adopted by teachers and this was recommended due to the fact that, learning efficiency and effectiveness takes place during discussion, experimentation and explanation
ii. Adequate interaction between physics student and teachers. In this case, it is believed that genuine and helpful interaction between the teacher and the students, will be able to expose their minds to what and when they find things difficult in physics concepts thereby reducing the difficulties and fear they encounter during learning.
iii. Recommendations for each topic to have a target and specific objectives to be met at the end of each lesson was made. This is necessary and important if physics is to be appreciated by the students and community at large. A topic would be appreciated if it has attainable aim, goals and objectives and if these are not met, then it is said to be aimlessly taught and of course, have no contribution to the development of the students in relation to cognitive, affective, and psychomotor domains and has nothing to contribute to the society at large.
iv. Each topic should co-relate and cut across board other topics, i.e., the knowledge gained previously should be transferable. This means that it has to contribute to new topic and aids the understanding of the new topic. Topics should be sequentially arranged in a logical order so that each knowledge gained could be retained, applicable and transferable to any physical challenges.
v. Evaluation should not only be based on recalling of facts but also on application. The affective and psychomotor (manipulative competencies). This recommendation is made such that students could be holistic in development relative to the demands of their societies.
vi. It was recommended that emphasis should be placed on both the theoretical aspect as well as practical aspect of the subject. This suggestion and recommendation were made so that any theory taught in physics will be tested and trusted to be consistent at any considerable situations

vii. Most importantly, each topics should be taught in a way that it takes into consideration its relevance to the societal norms and values etc. so that each student can appreciate the values and norms of the society in which he lives.

Objective of Physics Education in Nigeria

The general objectives of secondary school physics curriculum as stated in the curric ulum document of 1985 by Federal Ministry of Education (FME), revised in1998 and expressed explicitly by the FGN (2004) are:

i. To provide literacy in physics for functional living in the society.
ii. Creativity simulation and enhancement.
iii. Acquiring essential competencies and attitudes for technological application of physics.
iv. To acquire basic concept and principles of physics as preparation for further studies.

Besides, an array of performance, objective was also stated for each topic in physics. Ivowi (1993) emphasized some factors on the secondary school (SS 3) physics curriculum content:

i. Understanding the concept. That is, ability to explain concepts and principles in physics
ii. Functionality: that is, the use of functional equipment to expose students to the various processes and to enable them acquire relevant competencies.
iii. Application: competent in applying concept learnt and acquired in physics to relevant field.

The objectives listed above entails indispensable and laudable expressions that can cause noticeable changes to our national development if all collaborating factors shown in Figure 1 below are put into considerations.

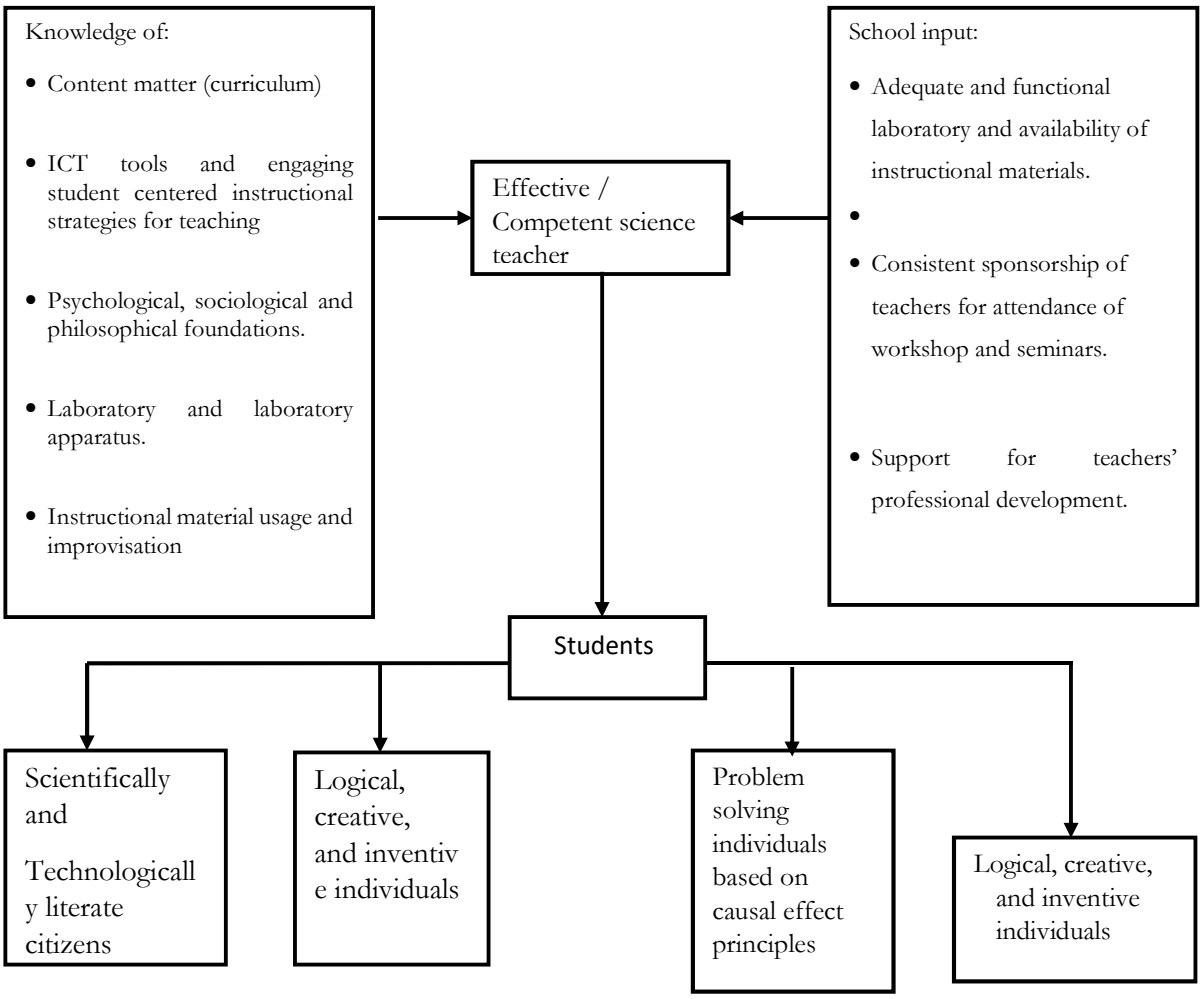

Figure 1: Input-Output science pedagogy model by Aderonmu & Obafemi (2015).

In all educational system, there is a place called school where activities of learner-teacher interaction takes place (Duru, 2011). Both students and teachers will be helpless if certain fundamental policies and facilities are not available to activate conducive teaching and learning environment. Issues that would have led to ordeal in physics instruction in secondary school are availability and functional laboratory and practical apparatus in the physics laboratories. Adegoke and Chukwunenye (2013) stated that lack of functional physics laboratory and inadequate apparatus for physics practical in most Nigerian secondary schools is hampering laboratory activities and these may be contributing to low level of performance and achievement of students in physics. Researches have shown that no meaningful science lesson can be taught with inadequate resources, ill-equipped laboratory and incompetent teacher (Ergin & Hirvonon, 2005 and Ottander & Grelsson, 2006).

Onwioduokit (2013) stressed that few secondary schools that have physics laboratory facilities and apparatus rarely put them to usage. This probably could be linked to physics teachers' lack of mastery of subject matter, incompetency and knowledge of laboratory apparatus usage.

Sullivan in Birabil and Aderonmu (2014) asserts that competent teacher is one who demonstrates knowledge of the curriculum provides instruction in a variety of approaches to varied students and evidently increases student's achievement. Such teacher is one who has gone through a level of professional training and is both certified with a teaching degree. Competent physics teachers are those who possess professional teachingcertificates in physics while incompetent physics teachers are those who do not possess adequate professional teaching qualifications in physics. The American Association of Physics Teachers (2009) listed six important attributes of a physics teacher:

i. A physics teacher believes in active learning; he knows effective instructional practices that will help their students learn science content through the processes of inquiry.
ii. The teacher has an interest and is passionate about his subject matter and possess sound knowledge of the curriculum.
iii. The teacher possesses good interpersonal and communication skills. Teachers are good communicators; good interpersonal competencies are fundamental for good teaching.
iv. Teachers believes all students can learn. Teachers understand that students will learn in relation to the expectations set for each of them.
v. The teacher is conscientious and painstaking. Individuals who are committed to their students and their work makes the best teachers.
vi. The teacher is a leader. Show me a good leader and I will show you a good teacher. Good teachers leads by example and encourage students to strive for excellence.

A competent teacher provides an enabling environment that allows students actualize their potentials, disseminate effectively physics instructions and develop students intellectually in confronting issues that requires reasoning. Since and the method of teaching it is dynamic and contemporary means of knowledge acquisition and teaching competencies are emergent and not absolute. Therefore, quality professional development is critical to the retention and improvement of any teacher in the laboratory.

Competency in Physics Practical

There are various approaches and definitions of competency. The encyclopedia Britannica defined competence as synonymous with skill, expertise or proficiency; also the Thesaurus English dictionary defined the word competence as akin to skill and in this work the researcher employed the word competency as the same as skill, proficiency or expertise and may use either words interchangeably.

Competency as basic ability is the means by which a person adjusts to life. In the work place, competency is what the workers give in exchange for remuneration. If the competency (or the cluster of competency popularly referred to as aptitudes) given is satisfactory, the worker gets satisfaction and the employer gets satisfactions in correspondence (Baiyelo and Adeyemo, 2001). This process, if sustained, culminates in promotion, retention and prolongation of tenured efficiency and productivity. On retirement from active working life, a person's repertoire of competencies will no longer be relevant to help him or her adjust to life. He or she needs new competency to enjoy leisure

and adjust to the contemporary approach to life. This situation is the same for a handicapped person, a widow or indeed any person whose way of life has changed rapidly. Hence a person's rehabilitation in these contexts requires new competency with special consideration to his or her aptitudes and work functions. In the case of young adults, holistic adjustment in the world of work will be based on skills learned and used initially at school and at work later; the socio-economic future of any nation will in time to come depend on it and these will determine the survival of such nation. In a laboratory, competency is the capacity to perform a tasks creditably. Up to a point, the more practice in the doing of specific task, the faster and better they can be done. It is linked with know-how while accuracy and speed are some of its characteristics. Ability to identify and evaluate these aptitudes in children for placement and promotion is a highly treasured experience which a good teacher has to possess. Until the 1940s, the study of competency was largely confined to industry. Employees were regarded as competent or skilled if they are able to carry out a trade or activity that involved knowledge and manual dexterity whereas qualifications are usually acquired as the result of long time training. In contrast, an incompetent or unskilled employee were not expected to perform task which cannot be learned within a relatively short time frame. This industrial definition of competency expressed fundamentally in terms of the amount of training and experience required for effective performance has remained essentially the same to the present time. This performance is not exclusively concerned with annual operations, it includes process control, and office as well as attempts to understand the human factors involved in decision making.

Competency is thought of as a quality of performance which do not depend solely on a person's fundamental, innate capacities but must be developed through training, practice and experience. Although, competency depends mainly on learning, it also includes the concepts of efficiency, economy and excellence in performance. Modern concepts of competency buttresses the flexibility and ease with which a competent operator reaches a given end on different occasions varying specific actions according to precise circumstances. Though, it must be reiterated that even though fundamental human capabilities are not adequate to produce competencies, they form the essential basis of their development. Competency depicts a special way of using capacities in relation to Environmental yarning. (Adeyemo, 2009). Surprisingly, although the concept of competency is intimately related to classroom activities and its measurement assessment and general evaluation may be central to the affairs of the school system, not much is done about it in teacher education program. Its records are also rarely kept in continuous assessment in schools irrespective of the national Policy on Education that requires teachers to make instruction concept centered, work related and activity based (F.M.E., 1981). An apparent neglect of policy as presented above well illustrates a major way in which standards are regularly compromised in Nigeria's school system. Baiyelo (1999) has shown that often times bending of policies, rules and regulations leads to various acts of indiscipline among stake holders in education, in the Implementation stage of the school curriculum. This fact underlines the need to concentrate on competency improvement on school instruction for the benefit of school and society.

Types of Competency and their Acquisition in Planning, Organizing, Laboratory Management and Evaluation of Physics Practical.

The great advantage of any task is that, if properly undertaken it helps both to develop and to reinforce competency. Although, attempt to catalogue a hierarchy of competencies will have a gap, it should not be the yardstick why we should not delineate competent areas. Generally, the type of intellectual competency commonly encountered in the school systems are as follows:

i. Motor skills
ii. Memory
iii. General cognitive (verbal, perceptual and quantitative)

These classifications and many more are in relative rather than in absolute term. A total of eighteen constructive tests was developed by McCarthy (1972) covering these intellectual competencies which she organized into six scales. These constructive tests include puzzle solving block building, pictorial memory, number questions, word knowledge, tapping sequence, arm coordination, verbal memory, right and left leg coordination and orientation, imitation action, draw a decision, draw a child, numerical memory, verbal fluency, opposite analogies, conceptual grouping, counting and sorting, These 18 separate tests assess the child's competency/ability in a crucial way. The tests have been grouped into six scales: verbal (V), perceptual-performance (P), quantitative (Q), general cognitive (GC), memory and motor. The first three do not overlap in content and when the tests constituting these three scales are considered altogether, they form the general cognitive scale. Thus the following relationship exists between the first four scales:

$$V + P + Q = GC$$

It is pertinent to noted that in each of the cases, acquisition of competencies do not increase basic capabilities, but improves the economy, efficiency and effectiveness in which they are used (Welford, 1976; Adeyemo, 2003). Also note that where the assessment, measurement and evaluation of competencies and skill impacts have been alluded to as problems in operating continuous assessment in schools, the question of efficiency, economy and effectiveness with which competency are performed has very often been overlooked. And it is probably more for this than other reasons that process competencies have been exclusively focused on school instruction whereas it is the competency, efficiency, economy and effectiveness that ensures high productivity (Adeyemo, 2009). The over emphasis and focus on process competencies to the exclusion and detriment of other types of competencies in school instruction is in part to be held responsible for the yawning gap easily noticeable between "work" in real life and "work" in school. Hence, effort should be made to investigate this neglect, identify its pervasiveness and types of competency involved and seek how to propagate and reinforce them and sensitize teachers to their measurement assessment and evaluation in order to bridge the huge gap between real life and school. The process of competency acquisition in line with Lofquist and Darwin (1976) and Hattie et al. (1996), can be thought of as a sequence of five stages thus:

i. Comprehension of the task.
ii. A temporal storage which gives time for more permanent, long term training to form.
iii. Passing material of long term store.

iv. Retention in long term store.
v. Retrieval for use Reinforcement requires that something must be learnt before it can be consolidated through reinforcement.

Eraut (cited in Orji &Abolarin, 2012) gave a definition of competency as the ability to perform a role or task to an expected standards. According to Weinert (2001) competence is a positive combinations of willingness, ability and knowledge of an individual to cope successfully and responsibly with challenging and changing situation. Similarly, Orji and Abolarin (2012) refers to competencies as the ability of one concerned to apply an acquired knowledge to achieve as desired results. These definitions expressed competence as changing over time, experience, space and setting (Okwelle 2014). Thus, competence as a concept cannot be communicated but can be developed over time. Teacher's competencies are tools for teaching and only those who possess all these knowledge, values and norms needed to function effectively in the laboratory situation are said to be competent enough to teach in that situation. Therefore teacher's competency in instruction delivery is sacrosanct in realizing the aims, goals and objective of physics education. Competency refers to the personality of a teacher in handling instructional process with the help of instructional methods and material resources. Katane and Selvi (2006), refers competency as "a set of knowledge and proficiency in creating a meaningful experience when preparing a task". As professionals, teachers' needs to plan, organize and implement the learning process, evaluate the learning outcomes, provide guidance and training and conduct research. Therefore, teachers must have professional educational capabilities. Competencies in this work are referred to the six components of the Physics teacher competency viz:

i. Experimental plan / designing,

ii. Organization,

iii. Laboratory management / hands-on practical,

iv. Evaluating a systematic and effective practical.

For effective and successful assessment in schools and to achieve quality education, the assessor must possess the required competencies and instructional materials which include; Test preparation technique; Test administration techniques; Critical observation techniques; Scoring, recording and reporting information techniques; Storing and retrieval capability; competencies for analyzing and synthesizing data; Ability to use and interpret the data collect; grading and categorization based on result obtained.

Critical review of literature on issues involved in teacher's competency improvement needs furnishes six aspects of findings. The first aspect reveals that: Physics teachers do not plan practical instructions conscientiously and effectively; Physics teachers do not organize instructions efficiently; Implementation of physics practical are not carried out to a logical conclusion; There is inefficient laboratory management by physics teachers during practical instructions; Un-availability and no utilization of instructional materials affect the quality of physics practical adversely; Physics practical instructions are not properly evaluated.

The second aspect of findings from literature review reveals that the teacher is the pivot of education life, the success of all fields of study revolving round teacher competencies. This finding is reminiscent of the universal law of planetary motion. Now, if the education system (comprising basically the teacher competencies and expertise and the different fields of study) can be likened to the solar system (comprising basically the sun and nine planets), then the teacher's position in the education enterprise fits exactly that of the sun which is the center of the solar system and around which the nine planets revolve, shining only by the reflected light of the sun. Should the sun be spent (which of course would spell doom for the entire system), other members of the Milky Way's/galaxy/solar systems will (individually) wallow in eternal darkness.

Expectedly, if a teacher is incompetent (as shown by review of literature), the respective fields of study will tend to be in limbo, needing urgent improvement. This expectation, probably, underlies Ajay's (2011) apprehension that the Nigerian education system is in a state of limbo, needing urgent revival", particularly for those fields of study that are a bedrock of sustainable development of the nation. Physics is a very crucial subject for technological development and as such its teaching and learning must be a matter of national concern.

Theoretical Framework

Piaget's Theory of Cognitive Development

Jean Piaget originally studied mollusks but moved to the studying of development of children's understanding, by observing them and listening to them while they worked on exercises set for them (Joubish & Khurram, 2011). Piaget's theory basically states that children must continually reconstruct their own understanding and knowledge through active reflection on objects and events till they eventually achieve an adult perspective (Gillani, 2013). To him, intelligence is represented by how an organism interacts with its environment through mental adaptation. This adaptation is controlled through mental organizations or structures called schema which an individual uses to represent the world, driven by a biological impulse to obtain equilibrium between those mental structures and the environment.

Generally, Piaget's work consists of two principal parts: first, his theory of adaptation and the process of using cognitive schemes; second, theory of cognitive developmental stages. The first aspect deals with the concepts of schema, assimilation, accommodation, and equilibrium. The second aspect posited four major stages of cognitive development that occur over a lifetime, namely, pre-operational, sensor motor, formal operational, and concrete operational.

Piaget's schemas are building blocks of intellectual development that adapts to environmental patterns as learners encounter new learning experiences (Anderson & Pearson, 1984). This adaptation occurs through assimilation and accommodation and is predicated on the belief that building of knowledge is continuous and self-construction. Assimilation itself is the cognitive process which integrates new patterns, data, or processes into their existing schemata (Gillani, 2003). As one interacts with the environment, knowledge is invented, manipulated and passed into cognitive structures.

According to Piaget (2001), the change that occurs in the mental structure of schemata is called accommodation. When discrepancies between the environment and mental structures occurs, the perception of the environment can be changed to allow for new information, or the cognitive structures themselves changes as a result of the interaction through accommodation. Series of related assimilations and accommodations results in equilibrium, a balance between mental schemes and the requirements of the environment (Lutz & Huitt, 2004).

The combination of maturation and actions to achieve a balance elevates an individual into a higher developmental level or stage. Basically, a stage is a period in a child's development in which he or she is capable of understanding some things but not others (Joubish & Khurram, 2011). According to Piaget, the sensorimotor stage (Birth to 2 years old) begins with the reflex actions of infants and proceeds through the development of basic concepts such as time, space, and causality. The sensorimotor stage ends with the starting of symbolic thought in the child. The Pre-operational stage (2 to 7 years) is characterized by the development of symbolic thinking and language. The concrete operational stage (7 to adolescence) is marked by a noticeable increase in the child's capacity to classify and analyze patterns according to the attributes of events and objects (Gillani, 2013). At this stage, children attain the cognitive ability of reversal and generalization. The formal operational (adolescence to adult) is marked by the ability to handle abstraction. Individuals at this stage can control variables systematically, test hypotheses, and make inferences.

One focal fact that emerges from an in-depth study of Piaget's work is the provision of frame of reference by which educators and educational technologists can analyze the behavior of the learner and design instructional environments within which students can control their own knowledge (Gillani, 2013). Piaget's philosophical and theoretical foundation provides answers to the questions of "why" and "how" specific pedagogy, including the application of cloud technology in learning, should be employed (Doolittle & Hicks, 2003). The cognitive constructivist world view dictates that the search for knowledge is the search for how the world really works and the value of knowledge is determined by its relationship with the real world (Prawat & Floden, 1994). Development of competencies is an indication of this quest by students' and teachers alike to enrich knowledge and construct true cognitive structures. The efficiency of teacher's competency in influencing students' prior knowledge in Piagetian cognitive constructivism provides that cognition is an active process of organizing, planning and implementing one's prior knowledge to make meaning of one's experience with the aim of constructing personal meaning, competence, and relationships (Wilson & Parish, 2010). Skillful planning, organization, management of learning environment efficiently by the teacher therefore present a convenient platform to evaluate the level to which students can connect prior knowledge to new knowledge, forming a basis for establishing personal and social meaning, creating a lasting impression on students that leads to conceptual shifts allowing complex and related information to be better organized, integrated, and meaningfully connected to action. Practical physics teacher's skillfulness open great doors that help students develop a sense of independent enquiry, productivity in creative thinking, and skills for analyzing information (Gillani, 2003).

B. F. Skinner Behavioural Theory of Learning

The emphasis of Behaviourism is observable indicators that learning is taking or has taking place. Contrasting this view of learning is the emphasis of cognitive psychologists who equate learning with the mental processes of the mind. Behaviourists accept the existence of these mental processes. In fact, they acknowledge their existence as an unobservable indication of learning.

B.F. Skinner in 1968 expanded on the foundation of Behaviourism, established by Watson, and on the work of Edward Thorndike in 1968, by emphasizing on operant conditioning. According to Skinner, automatic behaviour is either re-enforced or weakened by the presence of a reward or a punishment. "The learning principle behind operant conditioning is that new learning occurs as a result of positive reinforcement, and old patterns are abandoned as a result of negative reinforcement." In his book titled, The Technology of Teaching, Skinner wrote:

> The application of operant conditioning to education is simple and direct. Teaching is the arrangement of contingencies of reinforcement under which students learn. They learn without teaching in their natural environments, but teachers arrange special contingencies which expedite learning, hastening the appearance of behaviour which would otherwise be acquired slowly or making sure of the appearance of behaviour which otherwise never occur. (Skinner, 1968, p.64)

He believed that more complex learning could be achieved by this process of reinforcement and contingencies through successive stages in the shaping process and the contingencies of reinforcement being changed progressively towards the direction of the required behaviour." Operant conditioning has been widely applied in clinical settings i.e., behaviour modification as well as teaching i.e., laboratory management and instructional development like programmed instruction. By way of example consider the implications of re–enforcement theory in relation to the development of programmed instructions (Markle, 1969; Skinner, 1968.)

i. Practice should take the form of questions / stimulus – answer / response frames which exposes students to the subjects in gradual steps (the planning and organization competence aspect of teaching; in physics practical classes in particular students.
ii. Require that the learners elicit response for every frame and receive feedback immediately; (the application of instructional materials aspect).
iii. Arrangement of the difficult questions such that the response is always correct and hence a positive reinforcer; (the management and implementation stage).
iv. Ensure that good performance in the lesson is paired with secondary reinforcers such as verbal praises, prices and good grades (evaluation).

Edward Thorndike's Connectionism

In a report published in 1910 in the journal of educational psychology titled "The contribution of Psychology to education", Edward Thorndike introduced a set of principles that was known as Thorndike's laws. According to this law learning is achieved when one is able to form a relationship between stimulus and response.

This stimulus and responses are known as "habits", and can either be deterred or encouraged by external factors. This law highlight the importance of rewards and emphasise on the necessity of practice and repetition in a learning environment. More specifically, the law Readiness below suggest that a teacher can only instructs a student if that student is willing to be educated. When students do not show any sign or readiness teachers should provide activities that will help the student develop interest to learning. (Edward, 1999).

Thorndike suggested the Connectionism Theory based on the ideas presented by associationism. He hypothesized that certain elements become associated though similar experiences and that more complex ideas should be taught and explained through series of simplified theories. Four key principles of this theories are:

i. Learning involving both practice and reward (based on the law of effect).
ii. Linking of Stimulus and response associations if they are part of the same "action sequence" (based on the law of readiness).
iii. The transfer of learning and knowledge is based on situation that has been experienced by the individual previously.
iv. Intelligent is a factor of how many of these associations have been learned and acquired. This theory implies that teachers should plan, organise learning materials in a sequential ordered, planned organised, implemented and provide proper evaluation by means of effective examinations.

Bruner Constructivist Theory

The result of cognitive development is thinking. The intelligent mind forms from experience generic coding systems that allows an individual to go beyond the /data to new and fruitful predictions (Bruner, 1957, p.234). Bruner constructivist theory is a general frame work for instruction based upon the study of cognition. The ideas outline in Bruner (1960) originated from a conference focus on math and science learning. Bruner illustrated his theory in contents of mathematic and social science programme for young children focus on language learning in young children. He formulated three principles.

i. Instruction is concerned with experiences and contexts that makes students willing and able to learn (readiness).
ii. Instruction has to be structured systematically so that it can be easily grasped by the students (spiral curriculum this involved information being structured so that complex ideas can be thought at a simplified level first, and then re-visited at more complex levels later on). i.e., subject will be thought at levels of gradually increasing difficulty hence the spiral analogy. Ideally, teaching in this order should lead children to being able to solve problems themselves.

iii. Learning activities should be designed to facilitate extrapolation and or filling the gaps going beyond information

The role of the teacher should not be only to teach information by rote learning but instead to efficiently facilitate the learning process. This implies that a good and competent physics teacher will design practical physics lessons that helps student discover the relationship between bits of information. To do this a teacher must give student the information they need in a planned and organized sequence. The application of the spiral curriculum can aid the process of discovering learning which essentially features in physics curriculum and physics philosophy.

Empirical Studies

Effiong and Nkwo (2004) carried out a survey research in Cross River State, Nigeria on the assessment of physics teacher's practical competency as basis for improving teacher retraining programs. Specifically, the study attempted to determine the level to which physics teachers' competency capacity to guide practical sessions was relative to years of teaching experience, qualification and gender. One hundred and forty serving physics teachers (male 95; female 45) in the public and some private secondary schools in Cross River State constituted the population for the study which was selected through stratified (for gender) random sampling. The instrument for data collection was the (P-PAT) Physics teacher Practical Ability Test. The instrument was culled from the 2011 West African Senior Secondary Certificate Examination Alternative to Practical. The instrument consisted of two parts: Part A sought information about teachers and school teaching environment and Part B required teachers to answer the questions standardized already by WAEC). Relevant data analysis was done using the 2-way Analysis of Variance to test the hypothesis that teachers' competency capacity was not significantly influenced by the number of years of teaching experience, qualification and gender. Results showed that years of teaching experience and qualification significantly influenced teachers' competency capacity. It was recommended that packaging of content for teachers' re-training programmes among other things should be based on prior assessment of their competencies to allow for meaningful engagement of the teachers during the exercise. This will ensure that quality physics practical instruction is delivered to students which are basic for the promotion of economic development in Nigeria. This study though, did not itemize the competencies required for effective practical teaching and was carried out in Cross River state but the researcher in current work will try to itemize those competencies required for effective practical teaching in another work carried out by Shedrack and Mba (2012) on the effect of laboratory activities in teaching and learning of physics in Onitsha North of Anambara State of Nigeria in the line of survey research design were structured questionnaire was administered to teachers and students of physics in 10 secondary schools sampled from a total of 16 Government Secondary schools in Local Government Area. The instrument for collecting data were analyzed using a simple inferential statistic due to the conformity of the question and appropriate decision on the result based on the mean which was achieved through a comparison with the theoretical cut-off mean calculated as Xc= 2.5. The result of hisanalysis showed inability of students to explore diverse areas of physics as a result of ill-equipped laboratory, unsatisfactory teaching and learning due to obsolete nature of available material resources. These causes lack or

poor motivation for teaching and learning of physics. However, students with a wide variety of practical experiences are likely to perform better in skills and more confidence than those with limited experiences. This work however focused on effect of laboratory work which focused on student and teachers and was conducted in one local government of the state of Anambra while the present work will be focusing on Abia State as a whole and questionnaire administered to teachers alone.

Ovute and Ede (2012) in a work titled Teachers competency in development of diagnostic instruments towards quality assurance in teaching investigated the level of competency possessed by Secondary School teachers in development and use of diagnostic test instruments for identifying deficiencies in learners' understanding of classroom instructions. The study adopted a survey design. The population consisted of all the Secondary School (SSII) teachers in Abia State. A sample of 220 teachers (120 males and 100 females) was randomly drawn using simple random sampling technique in the two sampled education zones in the state. The researchers developed instrument was used for collection of data. Reliability of the instrument is 0.68. The instrument were administered on the sampled teachers by the researchers. The data that were collected was subjected to analysis using inferential statistics like mean, standard deviation and t-test. The results of the analysis revealed that secondary school teachers do not have the competency for development of diagnostic test instrument. They do not use diagnostic tests in classroom instruction. There was no significant difference in the competency level of male and female teachers on development of diagnostic test at 0.05 level of significance. This study on review was discovered to sample only two education zones of Abia State. It was not subject specific i.e. physics or chemistry. (SSII) teachers constituted the population while the current work will be considering the entire physics teachers from (SSI to SSIII if there are any) and will also consider the 3 education zones of Abia state. Also this work was on how to develop test instrument but this work will tend to go broader into planning, organizing, implementing, and laboratory management and evaluation of physics practical.

Akinbobola and Afolabi (2010) in their work titled Analysis of science process skills analyzed the science process skills in West African senior secondary school certificate physics practical examinations in Nigeria for a ten years period (1998-2007). Ex-post facto research design was employed for the study. Basic science process competencies comprised of observing, questioning,classifying, measuring, inferring, communicating, using numbers and using time/space relationships while integrated science process competencies are hypothesizing, controlling and manipulating variable, formulating models, defining operationally, designing experiment, and interpreting data; these physics practical competencies are science process skills (Ango, M. L.; Bybee, R. W.; and et al 1992). Five prominent science process skills identified out of the 15 used in the study are observing,manipulating, recording, calculating, and communication. The results also showed high percentage rate of basic lower order science process skills as compared to the integrated higher order science process skills. The results also indicated that the number of basic process skills is significantly higher than the integrated process skills in the West African senior secondary school certificate physics practical examinations. This study is targeted to students results after examination hence Ex-post facto research design was adopted but this present study will seek to determine if teachers of physics practical possesses this science

process skills/physics practical competencies in other to rob it off on student for excellent result during WASCE. The design for this present study is going to be a simple survey design and sampling randomly from the identified population of practical physics teachers in Abia State.

In another work carried out by Abimbade, (2007). Titled hierarchal study of science process skills in West African senior secondary school certificate physics practical examinations in Nigeria analyzed the science process skills in West African senior secondary school certificate physics practical examinations for the periods of 10 years (1998 – 2007). Ex-post facto design was used for the study. The 5 prominent science process skills identified out of the 15 used in the study which are manipulation17.20%, calculation14.20%, recording 13.60%, observation12.00% and communication 11.40%. The results also showed high percentage rate of basic lower order science process skills of 62.80% as compared to the integrated higher order science process skills of 37.20%. The results also indicated that the number of basic process skills is significantly higher than the integrated process skills in the WASSCE in Nigeria. This work though itemized the competencies for physics practical, it did not specify which competency Is for planning , organizing, classroom management, implementing and evaluation which is what the present work seeks to achieve and are focused on determining if physics teachers possess this competencies or not and the need for improvement.

Similarly at the international level also Elijah, Sati & Fredrick (2015) carried out a research in Kenya entitled Experimental Approach as a Method of Teaching Physics in Secondary Schools. Adoption of experimentation as a teaching methodology for Physics in secondary school is essential for successful concept delivery by subject teachers and concept mastery by the learners. Delivering quality content in Physics in most schools in Kenya, has been met with some challenges like inadequate and trained teachers, lack of Amenities and infrastructure taking for instance, Physics laboratory, laboratory apparatus, and lack of Laboratory Assistants personnel etc. For instance, in 2014 52% of teachers of Physics are untrained in the Gem District of Kenya (that is, they lack basic training to qualify them as physics teachers). The contribution of their study was to establish the influence of teacher-based factors on the use of experiments in teaching Physics in secondary schools in Kenya, case study of schools in Gem District. The study addresses specifically the influence of the teacher's professional qualification on the use experiments in teaching Physics; secondly, it established the influence of teacher experience and teaching load on the application of experimentation in teaching Physics and lastly, it established the influence of lesson plan on the use of experiments in teaching Physics. The study uses both descriptive survey and correlation research designs with a population of 32 participants. Data was collected using interviews and questionnaires. A pilot study was done in 3 secondary schools to test the reliability of the data instruments achieving Pearson's value of 80%. Both descriptive and inferential statistics was employed in analyzing the quantitative data while qualitative data was organized and categorized according to themes and sub-themes. The work was carried out in Kenya and it looked at the use of experiment as a teaching method for teaching physics, which showed that the problem of skills/competency, teacher's experience, lesson planning/preparation, and teachers professional qualification is a global one. Hence the present study will be in Nigeria and will look at skills of physics teachers in carrying out

physics practical, a pilot study may not be done in this case but descriptive survey will be used, both inferential and descriptive statistics will be employed to analyze the quantitative data obtained.

Purpose of the Study

The purpose of this study is to assess the practical competency improvement needs of secondary school physics teachers in Abia State of Nigeria. Specifically, the study seeks to:

i. Determine the competency needed by physics teachers in public and private secondary schools in planning of practical physics.
ii. Determine competency needed by physics teachers in public and private secondary schools in organization of practical physics.
iii. Ascertain the competency of physics teachers in public and private secondary schools in laboratory management.
iv. Determine the competency needed by physics teachers in public and private secondary schools in evaluation of practical.

Research Questions

The following research questions are raised to guide this study.

i. What are the competency improvement needs of physics teachers in planning practical physics in secondary schools in Abia State?
ii. What are the competency improvement needs of physics teachers for organizing practical physics in secondary schools in Abia State?
iii. What are the competency improvement needs of physics teachers for laboratory management in secondary schools in Abia State?
iv. What are the competency improvement needs of physics teachers in evaluation of practical physics in secondary schools in Abia State?

Hypotheses

The following hypotheses are formulated to be tested at 0.05 level of significance.

Ho_1: There is no significant difference in the competency improvement needs of physics teachers in public and private secondary schools on the competency required for planning physics practical.

Ho_2: There is no significant difference in the competency improvement needs of physics teachers in public and private secondary schools on the competency required for organizing physics practical.

Ho_3: Significant difference do not exist in the competency improvement needs of physics teachers in public and private secondary schools on the competency required for laboratory management.

Ho4: The competency improvement needs of physics teachers in public and private secondary schools on the competency required for evaluation of practical in physics do not differ significantly.

Methodology

Design of the Study

Descriptive survey research design was adopted for this study. The survey research design is a form of descriptive research that is aimed at collecting samples from populations in order to examine the distribution, incidence and interaction of educational and sociological phenomena (Denga & Ali, 1998). The survey design was considered appropriate for the study due to its scope of wide coverage in finding out and describing what is existing.

Area of the Study

The study was conducted in Abia State. Abia is a state in the south eastern part of Nigeria. The capital is Umuahia and the major commercial city is Aba. The State is bounded on the north and northeast by the states of Anambra, Enugu, and Ebonyi. To the east and southeast are Cross River State and AkwaIbom State, to the south is Rivers State and the west of Abia is Imo State. The State stretches between longitude 5º 25´North, and latitude 7º 30´East. Abia State, which occupies a landmass of about 5,834 square kilometers, with a population of 2,833,999 in 2006, now estimated at nearly 3 million (Thisday, 2012; Abia State Government, 2015), has three (3) senatorial zones and a total of 17 local government areas.

Abia State is home to several reputable higher educational institutions. These include: the Federal Government – owned Michael Okpara University of Agriculture at Umudike, the State Government – owned Abia State University in Uturu, the Gregory University Uturu (privately owned), Rhema University in Aba also (privately owned), and Abia State Polytechnic, Aba.

The choice is appropriate considering the global migration to an Information Age in which Abia as a State is not left out. The need for competency improvement and acquisition not only in commerce but in science and physics in particular has become imperative in order to fit-in, in the fast advancing technology globally.

Population of the Study

The population for the study comprises 308 physics teachers in public and private senior secondary schools in Abia State. The target population size is made up of 308 physics teachers drawn from the 48 private and 50 public senior secondary schools in the Abia State of Nigeria. (Secondary Education Management Board Umuahia, Abia State; SEMB, 2016).

Sample and Sampling Technique

The sample comprises 66 physics teachers drawn from the 48 Private and 50 Public senior secondary schools that offer physics in Abia State.

Multi-stage sampling technique was used for the study. Firstly, simple random sampling was used to sample one education zone from the three education zones (Aba zone, Umuahia zone, Ohafia zone), of which Aba education zone was selected. Secondly, stratified

random sampling was used to stratify Aba education zone into 9 Local Government Areas. Thirdly simple balloting was used to select 2 private and 2 public senior secondary schools offering physics from each of the LGA's. This was done to allow an even representation of the school categories in the sample. Finally, all the physics teachers available in the selected schools were selected as the sample for the study.

Instruments for Data Collection

The instrument for data collection is a researcher-developed questionnaire titled Practical Competency Improvement Needs Questionnaire (PCINQ). The PCINQ consists of 35 structured competency improvement needs questionnaire items. Part A seeks to obtain demographic information, while B is to obtain information on competency improvement needs of physics teachers for effective practical instruction in senior secondary schools in Abia State. Each competency improvement needs questionnaire item has a three-point scale of needs (Highly Needed given a value of 3, Averagely Needed given a value of 2, Not Needed given a value of 1) and performance (High Performance given a value of 3, Average Performance given a value 2 and Non Performance given a value of1). Each item has a level of performance and needed response attached to it where each respondent is expected to tick the level of performance of a competency and the level of need required for that competency in teaching practical physics in secondary schools.

Validation of the Instrument

The validation of the instrument for this study was done by three experts, one expert in physics Education, one expert in Measurement and Evaluation and one class room secondary school physics teacher. The experts in physics Education and measurement and evaluation are from Michael Okpara University of Agriculture Umudike, while the classroom physics teacher is from Boys Technical College Aba Abia State. The experts were required to face validate the instrument based on simplicity of language, and appropriateness of the constructed items in respect of the objectives of the study. Based on the recommendations of the experts, necessary modifications were made to the instrument. The validation yielded a total of 35 items after an initial effort of 75 items was subjected to thorough scrutiny. For instance, items initially lumped together in Section A as Basic Information were separated into different sections in line with the research questions. Some items of the PCINQ were dropped while others were modified to reflect the need for skill improvement. Another major outcome of the validation is the re-framing of the scale from the Strongly Agreed - Strongly Disagreed continuum into highly needed – not needed continuum and high performance – non-performance continuum, to indicate the skill improvement needs of physics teachers in teaching practical physics.

Reliability of the Instrument

To ensure reliability of the instrument, internal consistency reliability estimate was used to assess the consistency of the PCINQ which was trial-tested on 25 class room physics practical teachers in Imo State. Imo State was used for the pilot study because it is outside the study area. Results obtained from the pilot study were subjected to reliability analysis yielding a Cronbach's alpha coefficients of 0.72, for the need index, which indicates a strong measure of internal consistency in the instrument.

Method of Data Collection

The PCINQ was administered to physics teachers in the sampled schools and collected after the respondents had responded to the items. Data collection was handled by the researcher considering the fact that the sampled schools are all located in Abia State. This was also to avoid misplacement or non-completion of responses by the respondents.

Method of Data Analysis

Data was analyzed using both descriptive and inferential statistical tools. The research questions were answered using weighted mean and improvement need index (INI). In determining the performances of the teachers on each skill items, the following steps were followed.

i. The weighted mean of each item in the needed column was calculated (X_n).
ii. The weighted mean of each item in the performance column was calculated (X_p).
iii. The difference between the two means for each item (X_n- X_p) were determined for decision making by comparing the performance gap values with the improvement need index of 0, 1, and 2; where 0 means no improvement needed, 1 means improvement is averagely needed, and 2 means improvement is highly needed.
iv. The improvement need index obtained ranged from -2, -1, 0, 1,and 2; A need index value above 0 indicates that there is a skill improvement need while a need index of 0 and below means there is no skill improvement need for that professional skill item.
v. The decision criteria for establishing an improvement need was an improvement need index value above 0.

The research hypotheses were tested at 0.05 level of significance using the Student's t-test. The t-test was performed on the absolute values of the improvement need indices from the two school categories. The Student's t-test was used because it provides an appropriate measure of the statistically significant difference between two independent random samples from normal populations whose variances are not necessarily equal.

Results

The presentation of data analysis and interpretation for this study was done according to the research questions and followed by related hypotheses.

Research question one

What are the competency improvement needs of physics teachers in planning instruction in secondary schools in Abia State?

TABLE 1: Competency Improvement Needs of Physics Teachers in Planning Practical in Secondary Schools in Abia State

S/N	COMPETENCY ITEMS	LEVEL OF NEED		LEVEL OF PERFORMANCE		IMPROVEMENT NEED INDEX	REMARK
		$\bar{X}_n$	SD	$\bar{X}_p$	SD	$\bar{X}_n - \bar{X}_p$	
1	Identification of lesson / practical objectives	1.74	0.83	2.17	0.87	-0.43	Competency Improvement Not Needed
2	Identification of topics required in the curriculum for the teaching of practical physics	1.82	0.89	2.21	0.83	-0.39	Competency Improvement Not Needed
3	Identification of each student characteristics	2.45	0.73	1.5	0.67	0.95	Competency Improvement Needed
4	Determination of instructional materials / apparatus best suitable for accomplishing the unit objective	2.02	0.81	2.3	0.84	-0.28	Competency Improvement Not Needed
5	Identification of suitable teaching methods for easy comprehension by the students	2.59	0.61	1.5	0.71	1.09	Competency Improvement Needed
6	Designing the lesson / set up apparatus bearing in mind the objectives	2.68	0.66	1.55	0.64	1.13	Competency Improvement Needed
7	Identification of student learning styles and attention span	2.47	0.66	1.48	0.68	0.99	Competency Improvement Needed
	Cluster Mean					**0.44**	**Competency Improvement Needed**

The result in Table 1 show that there is a need for competency improvement in planning instruction among physics teachers in Abia State Nigeria, considering the cluster mean Improvement Need Index of 0.44 which is above 0. Specifically the results indicate that there is a need for competency improvement in the areas of identification of the characteristics of each student, identification of suitable teaching method for easy comprehension by the student, designing the lesson bearing in mind the objectives and identification of student learning styles and attention span.

Research question two

What are the competency improvement needs of physics teachers in organizing instruction in secondary schools in Abia State?

Table 2: Competency Improvement Needs of Physics Teachers in Organizing Practical in Secondary Schools in Abia State

S/N	COMPETENCY ITEMS	LEVEL OF NEED		LEVEL OF PERFORMANCE		IMPROVEMENT NEED INDEX	REMARK
		$\bar{X}_n$	SD	$\bar{X}_p$	SD	$\bar{X}_n - \bar{X}_p$	
1	Identification of Steps of the practical Lesson and time allotted to each Step.	2.62	0.74	1.33	0.59	1.29	Competency Improvement Needed
2	Inclusion of time for Re-teaching when Organizing practical Instruction.	2.64	0.57	1.24	0.58	1.4	Competency Improvement Needed
3	Assembling of different Resources / apparatus and teaching Modalities.	1.27	0.6	2.47	0.81	0.46	Competency Improvement Needed
4	Identification of time for Students Learning experiences and not merely listening, watching and taking notes (Delegation of task)	2.73	0.65	1.42	0.63	1.31	Competency Improvement Needed
5	Organization of Instructions to enable Student construct their own knowledge	1.33	0.62	2.76	0.61	0.72	Competency Improvement Needed
6	Organize Instruction to enable Student achieve and exceed mastery of the objectives.	2.71	0.67	1.47	0.59	1.24	Competency Improvement Needed
8	Provide Students opportunity to Demonstrate social competencies and self-regulation.	1.32	0.64	2.5	0.77	-1.18	Competency Improvement Not Needed
	Cluster Mean					**0.74**	**Competency Improvement Needed**

The result in Table 2, show that there is a need for competency improvement in organizing instruction among physics teachers in secondary schools in Abia State Nigeria considering the cluster mean Improvement Index of 0.74 which is above 0. the result specifically indicates that there is a need in the areas of identification of steps of the lesson

and time allotted to each step, inclusion of time for re-teaching when organizing instruction, assembling of different material resources and teaching modalities, identification of time for students learning experiences, organization of instruction to enable student construct their own knowledge and organization of instruction to enable student achieve and exceed mastery of the objectives.

4.1.3 Research question three

What are the competency improvement needs of physics teachers in laboratory management in secondary schools in Abia State?

TABLE 3: Competency Improvement Needs of Physics Teachers in Laboratory Mgt

S/N	COMPETENCY ITEMS	LEVEL OF NEED $\bar{X}_n$	SD	LEVEL OF PERFORMANCE $\bar{X}_p$	SD	IMPROVEMENT NEED INDEX $\bar{X}_n - \bar{X}_p$	REMARK
1	Confidence, communicative and leadership competencies.	2.77	0.55	1.17	0.48	1.6	Competency Improvement Needed
2	Maintain Discipline and orderliness in the laboratory.	1.38	0.6	2.62	0.63	-1.24	Competency Improvement Not Needed
3	Organize and implement Instruction in such a way as to optimize Student's access to learning apparatus.	2.59	0.72	1.29	0.65	1.3	Competency Improvement Needed
4	Continuous learner, imaginative and demonstrative competencies.	2.68	0.63	1.18	0.46	1.5	Competency Improvement Needed
5	Promote the development of Student social competencies and safety-regulation.	1.54	0.71	2.8	0.53	-1.26	Competency Improvement Not Needed
6	Use appropriate interventions to assist Students with behavioral problems.	2.8	0.5	1.32	0.61	1.48	Competency Improvement Needed
7	Maintain conducive learning environment for active and participatory learning	1.33	0.73	2.61	0.7	-1.28	Competency Improvement Not Needed

8	Identify any Safety considerations	1.41	0.72	2.77		0.6	-1.36	Competency Improvement Not Needed
	Cluster Mean						**0.08**	**Competency Improvement Needed**

In Table 3, the result shows that there is a need for the competency improvement in laboratory management among physics teachers in secondary schools in Abia State Nigeria, considering the cluster mean Improvement Need Index of 0.08 which is above 0. Specifically the result indicates a need in the areas of developing caring attitude and supportive relationship among students, organize and implement instruction in such a way as to optimize student's access to learning materials, utilization of group management methods that encourage student's engagement with academic task and usage of appropriate interventions to assist students with behavioral problems.

Research question five

What are the competency improvement needs of physics teachers in evaluation of practical instruction in secondary schools in Abia State?

TABLE 4: Competency Improvement Needs of Physics Teachers in Evaluation of Instruction in Secondary Schools in Abia State Nigeria

S/N	COMPETENCY ITEMS	LEVEL OF NEED $\bar{X}_n$	SD	LEVEL OF PERFORMANCE $\bar{X}_p$	SD	IMPROVEMENT NEED INDEX $\bar{X}_n - \bar{X}_p$	REMARK
1	Allow Students to perform hands on Activities probably individually or as a group during practical instructions	2.85	0.47	2.05	0.98	0.8	Competency Improvement Needed
2	Establish whether data collected from experiment is valid and reliable	1.55	0.77	2.61	0.63	-1.06	Competency Improvement Not Needed
3	Asking questions randomly at each stage of practical instruction	1.38	0.59	2.59	0.61	-1.21	Competency Improvement Not Needed
4	Giving practical assignment individually or as a group at the end of each lesson.	2.74	0.59	1.21	0.07	1.53	Competency Improvement Needed
5	Giving projects (e.g. Improvisation of practical equipment.	2.7	0.66	1.18	0.06	1.52	Competency Improvement Needed
6	Assigning Portfolios i.e. Project piled up to usher and publicize at the end of a term	2.53	0.75	1.48	0.71	1.05	Competency Improvement Needed
7	Building of a major experiment together with the student, e.g. Ray box, Transformers etc.	2.62	0.63	1.39	0.72	1.23	Competency Improvement Needed
	Cluster Mean					**0.55**	**Competency Improvement Needed**

The results shown in Table 4 indicate a cluster mean score of 0.55 for the competency improvement needs in evaluation of practical instruction amongst physics teachers in secondary schools in Abia State which is higher than the competency improvement need index of 0. This implies that there is a need in the areas of allowing students to perform hands on activities individually or as a group during practical instructions, giving practical assignment individually or as a group at the end of each lesson, giving projects, portfolios and building of a major experiment together with the students.

Research hypothesis one

There is no significant difference in the competency improvement needs of physics teachers in planning instruction in public and private secondary schools in Abia State Nigeria.

TABLE 5: t-Test Analysis of Competency Improvement Needs of Physics Teachers in Planning Instruction

School Categories	Mean	N	df	t-calculated	p-value
Public Schools	0.246	32			
			64	0.661	0.5209*
Private Schools	0.616	34			
Total		66			

*significant at $\alpha = 0.05$

From the result in Table 5, the P-value of 0.5209 which is greater than the 0.05 level of significance indicates that the null hypothesis is accepted. This implies that there is no significant difference in the competency improvement needs in planning instruction between physics teachers in public and private secondary schools in Abia State, Nigeria.

Research hypothesis two

There is no significant difference in the competency improvement needs of physics teachers in organizing instruction in public and private secondary schools in Abia State.

TABLE 6: t-Test Analysis of Competency Improvement Needs of Physics Teachers in Organization of instruction

School Categories	Mean	N	df	t-calculated	p-value
Public Schools	0.264	32			
			64	0.163	0.8734*
Private Schools	0.143	34			
Total		66			

*significant at $\alpha = 0.05$

From the results in Table 6, the p-value of 0.8734 which is greater than 0.05 indicates that there is no significant difference in the competency improvement need in organization of instruction between physics teachers in public and private secondary schools in Abia State Nigeria. The null hypothesis was therefore accepted at 0.05 level of significance.

Research hypothesis three

Significant differences do not exist in the competency improvement needs in laboratory management of physics teachers in public and private secondary schools in Abia State.

TABLE 7: t-Test Analysis of Competency Improvement Needs of Physics Teachers in Laboratory Management

School Categories	Mean	N	Df	t-calculated	p-value
Public Schools	0.104	32			
			64	0.052	0.9594*
Private Schools	0.065	34			
Total		66			

*significant at $\alpha = 0.05$

From the results in table 7, the P-value of 0.9594 which is greater than the 0.05 level of significance indicates that the null hypothesis is accepted. Thus this implies that there is no significant difference in the competency improvement needs in laboratory management between physics teachers in public and private secondary schools in Abia State, Nigeria.

Research hypothesis Four

The competency improvement needs of physics teachers in public and private secondary schools for evaluation of instruction do not differ significantly.

TABLE 8: t-Test Analysis of Competency Improvement Needs of Physics Teachers in Evaluation of Instruction

School Categories	Mean	N	Df	t-calculated	p-value
Public Schools	0.561	32			
			64	0.053	0.9582*
Private Schools	0.526	34			
Total		66			

*significant at $\alpha = 0.05$

From the result in Table 8, the P-value of 0.9582 which is greater than the 0.05 level of significance indicates that the null hypothesis is accepted. Consequently, there is no significant difference in the competency improvement needs in evaluation of instruction between physics teachers in public and private secondary schools in Abia State, Nigeria.

Discussion of Findings

The result displayed in table 1 indicated that the competency improvement needs of physics teachers in planning instructions are, identification of the characteristics of each student with a performance improvement need index of 0.95, identification of suitable teaching method for easy comprehension by the student with index of 1.09, designing the lesson bearing in mind the objectives with the index of 1.13 and identification of students attention span and learning styles with the performance improvement need index of 0.99, and since the performance improvement need indices are all above 0, these shows a high improvement need of teachers competencies in those areas. Planning is a deliberate process that results in teachers being well-prepared prior to walking through the classroom door for the day (Wharton-McDonald *et al.*, 1998). This is as established by a related study by Bain & Jacob (1990) who maintained that competent teachers see consistency in planning and organization in their laboratory important because they allow the central focus of laboratory activity time to be on teaching and learning. Research indicates that instructional planning for effective teaching includes the following elements: Identifying clear learning aims goals and objectives while carefully linking activities to them, which is essential for effectiveness (Cotton, 2005; Wikelund, 2005; Wharton-McDonald *et al,.* 1998); considering student attention spans and learning styles when designing lessons (Bain & Jacobs, 1990).

Teaching is a complex activity that involves careful preparation and planning objectives and activities on an hourly, daily and weekly basis. In addition, long-term planning ensures coverage of curriculum across a marking period, semester and year.

From Table 2, the competency improvement need index for the identification of steps of lessons and time allotted to each step was calculated to be 1.29, inclusion of time for re-teaching when organizing instruction was 1.4, assembling of different material resources and teaching modalities score of 0.46, identification of time for student learning experiences score of 1.31, organization of instructions to enable students construct their own knowledge score of 0.72 and organizing instruction to enable student achieve and exceed mastery of the objectives score of 1.24, are all above 0 which indicates a need for improvement in those competencies. Effective teachers reinforce their focus on instruction through their allocation of time to the teaching and learning process, and through their expectations for student learning (Cawelti, 2004; Cotton, 200; Molnnar *et al.,* 1999). This finding agrees with Bain & Jacob (1990) who rightly observed that organization in their laboratory is important because it allows the central focus of laboratory time to be on teaching and learning.

Results in Table 3 shows that the competency improvement need index for teachers confidence, communicative and leadership competencies was 1.60, organizing and implementing instruction in such a way as to optimize student's access to learning materials was 1.30, continuous learner and imaginative competencies was 1.50 and utilization of appropriate intervention to assist students with behavioral problems was 1.48, this implies a need for improvement for those competencies. The need for competency improvement of secondary school teachers in the afore mention competencies observed in this study is in agreement with the research findings of Okwelle and Chijioke (2014) and the assertion by National Research Council (1999) That an effective teacher is confidence, a mentor and knows how to guide students in the right direction and inspire others to be confidence, leading by example, a good role model, encouraging students and leading them to a place of success, being able to communicate clearly and concisely in order to get your points across not only to your students but with parents and staff. Teaching is a lifelong learning process. There is always something new to learn, the world is always changing, along with the curriculum and educational technology so it's up to the teacher to keep up with it, teachers need to be creative and think of unique ways to keep their students engaged in learning.

The result displayed in Table 5 shows that the competency improvement need of physics teachers in secondary school in Abia State are: allowing students to perform hands on activities probably individually or as a group during practical instruction with a performance improvement need index of 0.8, giving practical assignment individually or as a group at the end of each lesson with index of 1.53, giving projects with index of 1.52, assigning portfolios with index of 1.05, building of a major experiment with the teacher which has a performance improvement need index of 1.23, and a cluster mean = 0.55 which is above 0 indicates that there is a need for competency improvement of physics teachers in evaluation of instruction in secondary schools in Abia State. This has been observed (Dosumu, 2002; Adeola & Fajonyimi, 1999; Imo, 2012; Agu, Onyekuba & Anyichie, 2013) that teachers lack test construction competencies, most teachers receive little or no training or support after certification. Although, teachers are not expected to be experts in educational measurements and evaluation to construct valid and reliable tests, they need some basic knowledge on how to develop and validate their laboratory tests to enable them use results of their laboratory assessment for taking relevant decisions about the students.

The importance of good evaluation in the teaching/learning process that goes in science laboratory cannot be over-emphasized. (Adodo 2013) It is well established fact the the status and the kind of evaluation teacher uses in the laboratory has far reaching implications not only for students achievements specially but also for the nature of instructional procedure and feedback assessment reports on such students.

Conclusion

Insights into effective and efficient teaching especially in the 21st century and information age requires more than basic understanding of educational theory and classroom management, but also the development of awareness of the ethical responsibility intrinsic to the teaching profession not only in theory but through experience, adequate application of knowledge, attitudes, competencies, making content relevant to students daily lives, developing critical thinking in students, working with new and evolving technologies to create meaningful and effective lessons, giving students understanding and importance, having student work in teams to ensure all student receives an equal education and evaluating teaching and learning outcomes for decision making.

This study has specifically established that the Nigerian educational system lacks a coherent and well-articulated system of learning opportunities for teachers to continue developing expertise while in the laboratory. Opportunities are unevenly distributed cross schools, local governments and states, these calls for a substantial need for improvement in the competencies required by secondary school physics teachers in planning, organization, laboratory management and evaluation of instruction. The study was undertaken with the belief in the premise that professionalism and academic training are two distinctive words that are necessary prerequisite for good teaching effectiveness.

Obviously, a competent teacher recognizes academic instruction as central to his or her role. This focus on instruction guides not only the teachers own planning and laboratory behavior but also sees consistency and organization in their laboratory as important because they allow the central focus of laboratory time to be on teaching and learning. Teachers who participate in training can access better working conditions, developing qualifications and competencies should guarantee their capacity to adapt to changes in technologies and curriculum.

Recommendations

Teachers matter, but they do not work in vacuum. Their ability to elevate students scientific understanding depends on the schools communities and country in which they work and the professional communities which they belong. The following recommendations below are intended to address the issues identified in the conclusions with particular attention to the ways that the current education systems needs to be changed in order to support teachers ongoing learning they respond to the demands placed by current reforms in science education.

i. Personal effectiveness is key, the available evidence suggests that many science teachers have not had sufficiently rich experiences with the content relevant to the science courses the teach therefore, teachers should ensure they undertake higher training and qualifications to boost their confidence level and expose

themselves to wide range of teaching strategies in delivering lessons that are exciting and accessible.

ii. Schools need to be structured to encourage and support ongoing learning for science teachers especially given the number of new teachers entering the profession i.e. building school infrastructure that systematically develops the science and science teaching expertise necessary to engage all students meaningfully.

iii. Federal ministry of education should ensure they formulate policies and procedures that will equip (prospective) teachers with the knowledge, attitudes, behaviors and competencies they require to perform their tasks effectively in the classroom, school and wider community.

iv. The Secondary Education Management Board in Abia State in particular are central to building the capacity and efficiency of the science teachers, they should direct resources (e.g., location of teachers, scheduling of classes, materials budget) toward science and teachers learning in science, they can also send messages about the importance of science in schools

References

Abdu-Raheem, B.O, & Oluwagbohunmi, M.F. (2015). Pre-Service teachers problems of improvisation of instructional materials in social studies in Ekiti State University, *Journal of Education and Practice*,6(3),160-163.

Abia State Government (2015). Historical Background. Retrieved, 29th December 2015, fromhttp://www.abiastate.gov.ng/wp/about_us/historical-background/

Abimbade, A. (2007). Hierarchical study of science process skills in West African senior school certificate physics practical examinations, Retrieved 5th June 2016 from http://www.iiste.org/journals/

Adeola, A. O., &Fajonyomi, A. A. (1999). Adult learners' performance on standardized and non standardized tests as a function of sex and location. *Nigeria Journal of Counselling Development.* 4(1), 32-36.

Aderonmu, Temitope S. B & Obafemi, Deborah T. A (2015)Ordeals of physics instruction in Nigerian Secondary Schools: Way Forward for the Attainment of Global Competitiveness: *Journal of Education and Practice,* 6 (20). Retrieved,26th May 2016 from http://www.iiste.org/journals/

Adesoji, F. A. & Arowosegbe, O. (2004). Isolation of factors in teachers' perception of seniorsecondary chemistry practical in Nigeria. Retrieved from www.hbcse.tifr.res. in/episteme/episteme-2/e-proceedings/adesoji.

Adeyemo S. A. (2010) Teaching/Learning of physics in Nigerian Secondary schools: The curriculum transformation, issues, problems and prospects. *International journal of educational research and technology*Vol (1), 99 – 111. Retrieved from http://www.soeagra.com.

Adeyemo S. A. (2009). Understanding and acquisition of entrepreneurial skills: A pedagogical Re-orientation for Classroom Teacher in Science Education. *J. Turkish Science. Education.* 6(3), 56-64.

Adodo S. O. (2013) Correlate of pre-service teachers and in-service teachers perceived and prioritized students' psychological profiles for the teaching and evaluating Basic Science and Technology.*BST Journal of Emerging Trend in Engineering and applied science. (JETEAS),* 4 (2), 305-310.

Agbo, F. O. & Mankilik, M. (1999). The evaluation of the testing of practical skills in SSCE Examination. Proceedings of the 40th Annual Conference of Science Teachers of Nigeria (STAN), 37 – 40.

Agbola, O. S. & Oloyde, E. O. (2007). Effects of project, inquiry and lecture demonstration teaching methods on senior secondary students' achievement in separation of mixtures practical test. *Educational Research and Review,* 2(6), 124 – 132.

Agina-Obu, T. N. (2005). The relevance of instructional materials in teaching and learning. In Robert-Okah. I &Uzoeshi, K. C. (EdS). *Theories and practice of teaching.* Port Harcourt Nigeria: Harey Publication.

Agommuoh, P. C. (2015). Fostering creativity and improvement of secondary school students attitude towards physics: A Way forward for sustainable Development in Nigeria. *Literacy Information and Computer Education Journal.* 6(4) 10-12.

Agu, N. N., Onyekuba, C., &Anyichie, A. C. (2013). Measuring teachers competencies in constructing classroom-bassed test in Nigerian secondary schools: Need for a test construction skill inventory. Retrieved from http://www.academicjournals.org/article/article1379700583_Agu%20et%20al.pdf

Ajayi, S. A (2011). The contemporary challenges of education in Nigeria. A lead paper presented at the 7th annual National Conference of the Association for Encouraging Qualitative Education in Nigeria (ASSEQEN) at the Federal Government College of Education (FCE) Abeokuta, May10.

Ajeyalemi, D. (2011). Practical work in school science: Are the aims and objectives being achieved? Proceedings of the 52nd Annual Conference of STAN, 3 – 15.

Akinbobola, A. O., &Afolabi, F. (2010). Analysis of science process skills in West African senior school certificate physics practical examinations in Nigeria. *American – Eurasian Journal of Scientific research.* 5(4) 234-240.

Akpan, E. U. U. (1999). Towards evaluating chemistry laboratory practices: A survey of Plateau State secondary schools. Proceedings of 40th Annual Conference of STAN, 117 – 122.

Akporewhe, J. N. &Onwioduokit, F. A. (2013). Enhancing Scientific Attitude through Activity Based Approaches. Academia.edu Retrieved 24th July 2018 from http://wwwacademiai.edu/719335/Ehancing_Scientific_attitude_Activity_ baseed.

Anderson, R. A., and Pearson, P. D. (1984). A schema-theoretic view of basic processes in reading comprehension. In P. D. Pearson (Ed.), handbook of reading research. New York: Longman. pp 225-292.

Ango, M. L. (1992). Needed science process skills as foundation for effective technology education for national development. In P.O. Awotunde (Ed.):*Issues in Technology Education for National Development,* Jos: National Association of Teachers of Technology, 1: 92-104.

Bain, H.P. & Jacobs, R. (1990). The case for smaller classes and better teachers. Alexandria,VA: National Association of elementary school principals.*Eric Document Reproduction Service.* 5(8) 322 632.

Baiyelo T.D. (1999). Re-assessing Nigeria education future: Teaching staff quality and discipline. A lead paper presented at the South-South Zonal National Workshop, Port-Harcourt Nigeria. 29th November to 2nd December, 1999.

Baiyelo T.D, &.Adeyemo S. A. (2001). The need for skill assessment and evaluation of skill impact in simulating education and Productive work.*Lagos Educational Review.* 8 (1): 47-54.

Birabil T.S. & Aderonmu, T.S.B. (2014). Roadmap for national economic development: A focus on the teaching enterprise in Nigeria. *West African Journal of Business and Management Sciences.* 3(1A), 77 - 84.

Bruner, J.S. (1957). Going beyond the information given. New York, Norton. Retrieved from http://www.simplypsychology.org/bruner.htm.

Brunner, J. (1960). The process of education. Cambridge, MA, Harvard University Press. Retrieved from http://www.instructionaldesign.org/theories/constructivist.html.

Bybee, R.W., Buchwald, C. E., Crissman, S., Heil, D., Kuerbis, P. J., Matsumoto, C, & Mclnerney, J. D (1989). Science and technology for the elementary years: Frame works for curriculum and instruction. : National Center for Improving Science Education. Washington D. C.

Campbell, A., McNamara, O., & Gilroy, P. (2004). Practitioner research and professional development in education. SAGE Publications Limited.

Cassady, L. (2014). What are the primary purposes of education? Retrieved, 18th March, 2014 from http://www.ehow.com/m/info_8192984_primary_purpose_education.html.

Cawelti, G. (Ed.). (2004). Handbook of research on improving student achievement. 2nd ed. Arlington, VA: *Educational Research Service.*

Cotton, K. (2000). The schooling practices that matter most. Portland, &Alexandria, VA: Northwest Regional Educational Laboratory and the Association for supervision and curriculum development.

Cotton, K., &Wikelund, K. (2005). Parent involvement in Education. Retrieved 30th September, 2017 from http:/www.nwrel.org/.

Denga, D. I. & Ali, A. (1998). An introduction to research methodology and statistics in education and social sciences. Calabar Nigeria: *Rapid Educational Resources Publishers Ltd.*

Doolittle, P. E., & Hicks, D. (2003). Constructivism as a theoretical foundation for the use of technology in social studies. Blacksburg, VA: Virginia Tech. pp 1-31.

Dosumu, C.T. (2002). Issues in teacher- made test: Extent of goal attainment and imperatives for reform in STEM, Proceedings of the 52nd Annual Conference of STAN, 86 – 91.

Effiong, U. U. (2002). Physics classroom environment factors, cognitive preferencesn and achievement in physics among senior secondary school students in Cross River State. An Unpublished Ph. D. Thesis, University of Calabar, Calabar.

Ekundayo, B. S. (2013). *A Comparative Analysis of Student performance in economics in private and public Secondary Schools* in Kogi State Nigeria. M.ed Dissertation. Department of Arts and Social science Education. University of Lagos.

Elijah, O.O, Sati, P.L & Fredrick, M.A (2015). Experimental Approach as a Methodology in Teaching Physics in Secondary Schools. *International Journal of Academic Research in Business and Social Sciences.* 5(6), 38-86. Retrieved from DOI: 10.6007/IJARBSS/v5-i6/1011 URL: http://dx.doi.org/10.6007/IJARBSS/v5.

Federal Government of Nigeria (2007). National Policy on Education. Lagos Nigeria: Federal Government Press.

Federal Ministry of Education FME, (1981). National Policy on Education (Reviseded), Lagos Nigeria: Federal Government Press.

Federal Republic of Nigeria (2004). National Policy on Education. Lagos Nigeria: NERDC Press.

Gillani, B. B. (2003). Learning theories and the design of e-learning environments. Lutham, Maryland: American University Press.

Gillani, B. B. (2013). Cognitive theory and the design of education to work connection. Hayward, CA: California State University. pp 1-6.

Hattie J, Biggs J. & Purdie, N (1996). Effect of learning skills intervention in student learning. A Wetan Analysis. *Revised Education Research.* 66: 99-136.

Hodson, D. (1991). Practical work in science: Time for a reappraisal studies in science education. Retrieved, 13th January 2016 from http://waeconline.org.ng/e-lrning/physics/phys222nw.html,

Imo, G. C. (2012). Effects of training in test construction on quality of teacher-made test and students physics achievement in secondary schools in Plateau State Nigeria. An unpublished Ph.D Thesis, University of Jos, Jos Nigeria.

Ivowi, U. M. O. (1993). Curriculum Development in Nigeria. Sambookman Education and Communication Services Ibadan.inLegge D (Ed.) (1970). Skill. Pegan Books, England, U.K.

Ivowi, U. M. O. (1984). Misconceptions in physics among Nigerian secondary school students. In Physics Education,*A journal of Science Education.* 19,279-285.

Ivowi, U. M. O. (2000), Science education in Nigeria since 1960. *A Paper for Nigeria, University of Lagos*,July-August Presented at National Conference in Comparative Education.

Iwu, R. U. Ijioma B. C., Onoja, A. I. & Nzewuihe, G. U. (2011). Teaching aids. A panacea for effective instructional delivery in biology. 3(2), 62-65. Retrieved, 30th March, 2016. fromhttp://www.sciencepub.net/researcher/research0302/08_4388research0302_62_65_teach.pdf

Jegede S. A &Adedayo J. O (2013). Enriching physics education in Nigeria towards enhancing a sustainable technological development. *A Greener Journal of Education Research,* 3(2) pp 80-84.Retrieved, 21st May, 2016.fromhttp://www.gjournals.orgpdf1822064.

Johnstone, A. H. & Al-Shuaili, A. (2001). Learning in the laboratory: Some thoughts in sciences.

Joubish, M. F. &Khurram, M. A. (2011). Cognitive development in Jean Piaget's work and its implications for teachers. *World Applied Sciences Journal,* 12(8), 1260-1265

Katane and Selvi, (2006). Teacher competence and further education as priorities for sustainable development of rural school in Latvia. *Journal of Teacher Education and Training.* 6. 2006:41-59.

Kunter, M., &Baumert, J. (2006). Who is the expert? Construct and criteria validity of student and teacher ratings of instruction. *Learning Environments Research.* 9 (3), 231-251. Retrieved fromhttp://dx.doi.org/10.1007/s10984-006-9015-7.

Markle, S. (1969). Good Frames and bad (2nded.) New York: Wiley.

Maskill, R. (2000). A practical class that didn't work – what's the problem? http://www.ul.ie/-childsp/CinA/Issue58/TOC3_Practical Class.htm.

McCarthy, D. (1972). Manual: McCarthy Scale of Children's abilities. The McLeod, S. A. (2008). Bruner. Retrieved from www.simplepsychology.org/bruner.html.

Millar, R. (2009). Analysing practical activities to assess and improve effectiveness. The Practical Activity Analysis Inventory (PAAI). http://www.york.ac.uk/depts/educ/research/ResearchPaper Series/index.htmmore.Retrieved from http://carbon.ucdenver.edu/~bwilson/TLE.pdf.

Molnar, A., Smith, P., Zahorik, J., Palmer, A., Halbach, A., & Ehrle, K. (1999). Evaluating the SAGE program:Apilot program in targeted pupil-teacher reduction in Wisconsin. *Educational Evaluation and policy Analysis,* 21(12), 165-178.

Nnaka, C. V. &Anaekwe, M. C. (2011). Admission policy in sciences. *International journal of educational research and technology,* Vol (1), 99 – 111. Retrieved from http://www.soeagra.com.

Nwankezi, A.U. &Ifionu, E.P. (2010). *Challenges of Nigeria Teachers Education in the 21st Century*. In E.C Iloputaife, B.U. maduewesi, and R,O. Igbo (Eds.). Issues and Challenges in Nigerian Education in the 21st Century. Onitsha: West and Solomon Publishing Co. Limited.

Obioma, G. (2009). Federal ministry of education senior secondary school curriculum: Physics for Senior Secondary Schools. Abuja: Nigerian Educational Research and Development Council.

Okonkwo, A.F. (2014). Collaborative Instructional trategy and Essay Writing among Senior Secondary School Students. Unpublished Ph.D Thesis submitted to the department of Arts and Social Science Education, Ebonyi State University, Abakaliki, Nigeria.

Okpala, C. O. (2002). Educational resources, student demographics, and achievement scores. *Journal of Education Finance*, 27, 885-907.

Okwelle, P. C. (2014). A Paper presented at teachers' development workshop on enhancing teachers' competence in the Use of practical instructional materials in senior secondary schools, sponsored by Total E&P Nigeria Limited / NNPC; facilitated by Levinda Nigeria Limited, held at Akabuka, Rivers State.

Oladejo, M. A.; Olosande G. R., Ojebisi, A. O. &Isola, O.(2011). Instructional materials and students academic achievement in physics: Some policy implications. *European Journal of Humanities and Social Sciences,* 2(1), 112–123. Retrieved, 30th March, 2016. fromhttp://www.journalsbank.com/ejhss_2_4.pdf.

Omosewo, E. O. (2001) In service programmes for senior physics teachers for improved teaching and assessment of students. Nigerian Journal of Development Issues: Education socio-political and Economic Development, 5(1&2), pp200-219.

Omosewo, E. O. &Salami, I. O. (2002). Teachers assessment of the secondary school integrated science curriculum. *A Journal published by the faculty of education and extension Services, Usman danfodiyo university, Sokoto Nigeria.*Sokoto education review 5(151-161).

Onosanya, S. A &Omosewo, E. O. (2011). Effect of improvised and standard instructional materials on secondary school students' academic performance in physics in Ilorin, Nigeria. *Singapore Journal of Scientific Research,* 1(1), 68 –76. Retived, 30th March, 2016 from http://www.scialert.net/fultext/?doi+sjsres.2100.68.76

Ookwelle, Paulinus&Chijioke. (2014). Enhancing Teachers Competence in the use of Instructional Materials in Electronics Education in senior Secondary schools in Nigeria. *Journal of Humanities and social Sciences* .4. 2225-484. National Resaerch Council (1999). Selecting Instructional Materials: A Guide for K-12 Science. Washington, DC: The National Academies Press. Doi: 10.17226/9607.

Orji, U. E. &Abolarin, E. (2012). Strategies for enhancing teacher competence and quality of classroom instruction. Global Voice of Educators, 1(1), 1 - 6. Retrieved, 30th March, 2016 from http://www.globaleducators.org/downloads/global…/Journal%202012-%2028.pdf.

Ovute, A. O. &Ede, M. O. (2012). Teacher's Competency in Development of Diagnostic Instrument Towards quality Assurance in teaching. *LIT Academic Journal: An International Multi disciplinary Publication.* 1(2). Abigail, N. O.(Ed). Enugu State University of Science and Technology (ESUT).

Phillips, R., Kennedy, G. S., &McNaught, C. (2012). The role of theory in learning technology evaluation research. *Australasian Journal of Educational Technology,* 28(7), 1103-1118.

Piaget, J. (2001). The psychology of intelligence (2nd Ed.). London: Routledge. [originally published in 1950].

Prawat, R. S., &Floden, R. E. (1994). Philosophical perspectives on constructivist views of learning. Educational Psychology, 29(1), 37-48 Psychological Corporate U.S.A, Monte soil Maria (1912). The Monte soil Method New York. Fredrick A. Stokes.

Rosenshine, B. (1986). Teaching functions In M.C Wittrock (Ed.) Handbook of research on Teaching (3rd ed.) (pp. 376-391). New York: Macmillan.

Shedrack, I. M and Ikem, I. U. (2012). The Effect of Teaching and Learning of Physics in Onitsha North, Anambra State. *Journal of Science and arts.* 1(18) pp75-84.

Skinner, B.F. (1968).The technology of teaching. New York: Appleton-century-crofts.

Tennyson, R. D. (2010). Historical reflection on learning theories and instructional design. *Journal of Contemporary Educational Technology*, 1(1), 1-16.

Thorndike, L. & Reinemeyer, E. E. (1999). Neural Computing Surveys, 1(2), p18-72. Muskingum University. Retrieved , from http:// e-learningindustry.com/connectionism.

Trowbridge, L. W. &Bybee, R. W. (1990). Becoming a secondary school science teacher (5th ed.).Columbus, Ohio: Merrill Publishing Co.

Udofot, M. A. (2006). Challenges of Teachers Education and Professionalism in AkwaIbom State. *A Paper Presented at AkwaIbom State Education Summit* Held at Ibom Hall, IBB Way, Uyo, 14th – 16th March.

Uduak U. Effiong&Nkwo, I. N. (2014). Assessment of physics practical skills capacity as a basic for improving teacher re-training programmes. World Educators Forum. 4 (1)

United Nations Education Scientific and Cultural Organization - UNESCO (2012). Challenges in Basic Mathematics Education.

UpinderDhar & Gyanamamrtum, (2014). Inculcating Values through education. Retrieved, 29th July, 2017 from https://gyanamamritum.worldpress.com/2014/03/14/inculcating-values-through-education/

WAEC (2015-2017), Statistical Result. Retrieved, 2nd October, 2017 from https://waec.org/ng

Wang, M., Brown, F., & Ng, J. W. P. (2011). Current instructional design models and principles for effective e- and mobile learning. *Educational Web of San Diego State University [eJournal]*.

Weinert, F. E. (2001). Concept of competence: A conceptual clarification, in: D.S. Rychen& L. H. Salganik (Eds) Defining and selecting key competencies (Gotingen, Hogrefe).

Wharton-Mcdonald, R., Pressley, M., & Hampston, J. (1998). Literacy instruction in Nine first-grade classrooms: Teacher characteristics and student achievement, *Elementary School journal,* 99 103-119.

Wilson, B. G., & Parrish, P. (2010). Transformative learning experience: Aim higher, gain higher. *International journal of educational research and technology,* Vol (1), 116 – 119. Retrieved from http://www.soeagra.com