FACTORS AFFECTING QUALITY AND EFFECTIVE PRACTICAL WORK IN SENIOR SECONDARY SCHOOL PHYSICS IN EBONYI STATE OF NIGERIA

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ABSTRACT

This study was carried out to identify the factors affecting quality and effective practical work in senior secondary school physics in Ebonyi state of Nigeria. One research question was developed in line with the purpose of the study. One null hypothesis was formulated and tested at 0.05 level of significance. The study adopted descriptive survey design. The population of the study is 207, and the sample comprised one hundred (100) public senior secondary school teachers from the area of study. This sample was drawn using multi-stage sampling technique. A–15 item instrument termed "Physics Practical Work Questionnaire (PPWQ)" was used by the researcher for data collection. The instrument was first validated by three experts and reliability was determined using Cronbach Alpha Statistics and the reliability got was 0.92. The administration and retrieval of instrument were through direct contact and use of research assistants with the respondents. Data collected were analysed using mean and standard deviation for the research questions while t-test statistics were used for testing the null hypothesis. The findings of the study revealed that items presented are factors affecting quality and effective practical work in senior secondary physics in Ebonyi state of Nigeria. Findings on the hypothesis tested revealed that there was no significant difference in the mean responses of teachers of physics from urban and rural schools in Ebonyi state on the items presented. It was recommended that government and none governmental organizations should assist in the provision of the required facilities for effective teaching of practical physics in secondary schools in Ebonyi state.

INTRODUCTION

Physics is an active, experimental and practically-oriented subject and its concepts find applications in our everyday life. According to Feynman, Leighton and Sands (1963), physics is a part of natural philosophy and a natural science that involves the study of matter and its motion through space and time, along with related concepts such as energy and force In a related development, Young and Freedman (2003) described physics as an experimental science involving the study of matter and energy, space and time.

Two major reasons for studying physics were equally identified to include, firstly, physics is the most fundamental science, and scientists of all disciplines make use of ideas of physics, from chemists who study the structure of molecules to palaeontologists who try to reconstruct how dinosaurs walked. Furthermore, Young and Freedman (2003) noted that physics is also the foundation of all engineering and technology, as no engineer could design any kind of

practical device without first understanding the basic physical principles involved. The second reason adduced by Young and Freedman (2003) is that the study of physics is an adventure. Accordingly, they noted that the study of physics is challenging, sometimes frustrating, occasionally painful, and often richly rewarding and satisfying. Physics is therefore the branch of science concerned with the nature, structure and properties of matter and it contributes enormously to the economy of any country. It plays a central role in many different sectors of industry such as telecommunications, architecture, engineering, electricity production and transmission, construction, and transport. It also provides employment for people who are in occupations that are engaged in physics as a scientific discipline – for example teachers, scholars, and other researchers. It is thus an indispensable part of any country's economic development. Furthermore, physics often provides the foundations for other disciplines such as biology, medicine and chemistry. It enables learners to develop analytical skills necessary for problem solving in various situations they encounter in life. All technology is beholden to physics due to its emphasis on addressing phenomena involving the interaction of matter and energy. This interaction is necessary for the technological needs of the changing society (Juceviciene and Karenauskaite, 2004; Zhaoyao, 2002). In Ebonyi state of Nigeria, few students choose to pursue the subject during the last two years of secondary school (Onah and Ugwu, 2010). Teaching is geared around memorization of basic concepts and their reproduction in the examinations (Sadiq, 2003). The students who enrol for the subject resort to cramming definitions and formulae. Consequently it is difficult for even the high achievers to apply what they have learnt in novel situations. Usually the performance in physics is among the worst among all the subjects at the school leaving level (WAEC, 2003, 2006, 2010). Strategically, the demand for physics should be growing due to its strong influence on technology programs at university and other tertiary institutions of learning. The low enrolments in senior secondary school physics has been linked to a shortage of inspirational and well trained physics teachers, inadequate laboratory facilities and the accompanying limited exposure to practical instruction at junior secondary school level (Daramola, 1987). The science teachers are mainly trained in theoretical content aspects. Training in handling physics practical lessons has been ineffective in many developing countries including Nigeria. Training in conducting school type science experiments is completely ignored in many university teacher training curricula. Many of all the Nigerian university trained Bachelor of Education (Science) graduates lack the skills of handling high school type of practical work. There are no school-type laboratories set aside for this exercise in the various universities and colleges that train teachers (Masingila and Gathumbi, 2012). Being a science subject, effectiveness of teaching physics should be judged by the kind of practical activities that teachers and students are engaged. The consequence is that the physics teachers lack the skills for effectively guiding learners in conducting laboratory work. The attendant advantages of performing practical work are lost on the learners. Practical work may be considered as engaging the learner in observing or manipulating real or virtual objects and materials (Millar, 2004). Appropriate practical work enhances pupils' experience, understanding, skills and enjoyment of science. Practical work enables the students to think and act in a scientific manner. The scientific method is thus emphasized. Practical work induces scientific attitudes, develops problem solving skills and improves conceptual understanding (Tamir1991). Practical work in physics helps develop familiarity with apparatus, instruments and equipment. Manipulative skills are acquired by the learners. Expertise is developed for reading all manner of scales. The observations made

and results obtained are used to gain understanding of physics concepts. Science process skills, necessary for the world of work are systematically developed (Manjit, Ramesh and Selvanathan, 2003). First-hand knowledge is generated. Abstract ideas can be concretized. Naïve, neonate and scientifically primitive ideas can be challenged (Osborne, 2002). Tacit knowledge of scientific phenomena can be gained (Collins, 2001). Practical work creates motivation and interest for learning physics. Students tend to learn better in activity based courses where they can manipulate equipment and apparatus to gain insight in the content. Millar (2004) has suggested that practical work should be viewed as the mechanism by which materials and equipment are carefully and critically brought together to persuade the physics learner about the veracity and validity of the scientific world view. If practiced in the right manner from the early secondary school period, critical thinking skills can be attained from practical work in physics. This research acknowledges the great role that a well-planned and delivered practical work in physics can play in influencing students learning physics among senior secondary school students in Ebonyi state of Nigeria. For this to happen, practical work has to form a central part of classroom learning of physics. Deliberate efforts have to be made to attract and retain the students into the physics class by appealing to the curiosity raising element and discovery component of practical work in the subject. Meaningful practical work is always embedded in a discussion of ideas that make it necessary to check observations and findings against experience and theory.

Statement to the problem

Students' enrolment in physics courses at all levels is low in many African countries especially among the female students. Reasons for this range from inadequate lower level preparation, weak mathematics background, lack of job opportunity outside the teaching profession, inadequate teacher qualification as well as possession of below standard pedagogical content knowledge (Semela, 2010). Many students consider physics as difficult, abstract and theoretical (House of Lords, 2006). The subject is considered devoid of applications in the day to day life. Many students find the subject boring and unenjoyable (Hirschfeld, 2012). Interest in senior school physics is decreasing, learning motivation is declining, and the examination results are getting worse (Garwin and Ramsier, 2003; Manogue and Krane, 2003). In many school setting, little time is allotted for the subject compared to English language and mathematics, which are other important subjects (Tesfaye and White, 2012; UNESCO, 2010). The improvement on the students' performances in any subject in school is influenced by the students' interest towards that subject. Students appear to believe that the most problematic subject to study is physics, though not because of its difficulty but as a result of poor perception and negative attitude towards the subject. Accordingly, Eze (2006) and Adedoyin(2008), observed that students generally shy away from the core sciences due to perceived difficulty and wrong attitudes. There are shortages of academic and professional physics teachers in our secondary schools, as well as shortages of resource materials for carrying out laboratory activities in physics, Physics requires a lot of mathematics and the students lack the basic mathematical background. With all these in view, it becomes very pertinent to point out that practical work in senior secondary physics is not properly taught, and the expected objectives of teaching are not met. The problem identified created low students enrolment in physics, low performances in the subject and the consequent negative attitude toward the subject which generally results from some pertinent factors in which this study is aimed at identifying.

Scope of the study

The study focuses and is limited to finding the factors affecting quality and effective practical work in senior secondary physics. The study is also focused on the public senior secondary schools in Ebonyi state of Nigeria.

Purpose of the study

Generally, the main purpose or aim of this study is to find out the factors affecting quality and effective practical work in senior secondary school physics in Ebonyi state of Nigeria. The study also tries to establish how the identified factors relate with the location of schools- whether rural or urban.

Significance/Justification of the Study

The findings of this study will re-elevate the status of physics as the fundamental science among students and other stakeholders in the educational and technological sectors of Ebonyi state in particular, and Nigeria in general. The findings shall be of great benefit to the following people; education policy makers, teachers, students, curriculum planners and researchers.

Research questions

The following research question guided the study.

What are the factors affecting quality and effective practical work in senior secondary school physics in Ebonyi state of Nigeria?

Hypotheses

The following null hypothesis was developed in the study and tested at 0.05 level of significance. They are:

H_O There is no significant difference in mean responses of teachers of physics from rural and urban schools of Ebonyi states on the institutional factors affecting quality and effective practical work in senior secondary school physics in the state.

Concept of Physics Education

In the recent time there has been much drive in Nigeria towards scientific and technological development. The National Policy on Education (2004) chapter 5 Section 39, sub-section 1, notes that a greater proportion of educational expenditure will be devoted to science and technology. The development of any society is measured by the level technological advancement of the people. It therefore implies that a society with high level of technology would then be regarded as being developed (Jegede and Adebayo, 2013). Physics education is therefore a major factor in enhancing science and technology development.

The national education scheme designed for secondary school physics (1985) has it that the objectives of studying physics include the following;

- to provide basic literacy in physics for functional living in the society;

- to acquire basic concepts and principles of physics as a preparation for further studies;
- to acquire essential scientific skills and attitudes as a preparation for the technological application of physics; and
- to stimulate and enhance creativity (Federal Ministry of Education, 185, p.5)

Thus, for national development in technology, basic concepts and principles of physics are indispensable. The teaching of physics in secondary schools is intended to produce young scientists who would be able to design the technological devices that would make day-to-day activities easier and living more comfortable (Ajayi, 2008). It thus implies that physics is one of the pivotal subjects in technology. The teaching and learning outcomes of this all important subject need serious attention in other to enhance a sustainable technological development in Nigeria.

Problems of Physics Education

Jegede and Adebayo, (2013) noted that a careful analysis and appraisal of physics education in Nigeria reveals some fundamental problems which include;

- Curriculum content: The Physics curriculum content being used in Nigerian secondary schools presently cannot cope with the challenges of 21st century strive towards technological development. The curriculum does not take into consideration the cultural values and beliefs of the society for which it was designed.
- Teaching methods: The teacher's methods of teaching go a long way in enhancing effective learning by the students. The traditional method of teaching renders the students passive learners.
- Teachers' quality: The teacher is the facilitator who is to impact into the students concepts expected to be learnt. Lack of quality and dedicated teachers has been a major stumbling block in learning physics.
- Negative attitudes of students towards Physics: The majority of the students in secondary schools in Nigeria, perceived physics as a very difficult subject. The impression cuts across the gender. The cause of the negative perception of students towards Physics was identified by Adedayo (2008) to include the fear of the mathematical skills involved, harsh teacher-students' relationship, students' non-readiness to study, preconceived bad information that Physics is a difficult subject and poor method of teaching. This impression greatly affects students' readiness and interest to the study of physics. The consequence of this is felt on the expected technological growth of the country.
- Students' ignorance of the relationship between Physics and the environment: Students' ignorance of the relationship between physics and the environment manifests in their failure to relate physics to relevant societal and environmental problems thereby making them to study the subject without objectivity or interest.
- Teaching materials: The importance of instructional materials in the teaching-learning process cannot be overemphasised. Certainly no effective physics teaching can take place without learning materials, equipment and practical activities.

Concept of quality in education

Afemkhe (1988) confirmed that quality is an extension of standard. Coombs (1985) considered quality in terms of education as it concerns students learning achievement, the relevance of what is taught and learned, and the significant changes in input (students, teachers, facilities and suppliers) objectives, curriculum, educational technology and political environment. According to Okeke (2001), quality in education connotes standard of education, quality of service, quality of management, relevance, significance and efficiency of product. Quality is quite important in our educational system. The Federal Government in realizing this, saw quality as the guiding principle in our educational planning and thereby came up with this in Section 8B (70a) of the National Policy on Education (2004), Since no education system may rise above the quality of its teachers, teachers education shall continue to be given major emphasis in all educational planning and development. Quality and effective practical work in senior secondary school physics should make for the realisation of the objectives of the curriculum and achievement of technological advancement.

Review of empirical studies

Amadalo, Nkhanu and Wekesa (2012) carried out a study on the effect of practical work on girls' performance, attitudinal change and skills acquisition in secondary schools in Kenya. The study identified practical work as an influencing agent in the process of learning physics. By enabling the girls to carry out practical investigations, theoretical implications are clarified. The study involved two groups of girls from three sampled medium performing schools in Western Kenya. The experimental group was exposed to intensive practical work. The control group was conventionally taught the same content. A performance test of reliability index, $\mathbf{r_{xy} = 0.879}$ was administered to both groups at the end of form two. Comparison in terms of achievement on the test, attitude developed towards physics, science process skills learnt, and relative choice to pursue the subject in form three for the two groups was made. The experimental group outperformed the control group in all the research objectives. Onah and Ugwu (2010), worked on the factors which predict performance in secondary school physics in Ebonyi north educational zone of Ebonyi State, Nigeria. The study was carried out in 20 secondary schools in Ebonyi North Educational Zone of Ebonyi State. The data generated from the study were analysed using relevant statistical tools. It was found that school location and interest of students had no significant effects on performance in physics while performance in physics at this level depended on sex (gender), teacher qualification and laboratory facilities. Similarly, Olufunke (2012) studied the effect of availability and utilization of physics Laboratory Equipment on students' academic achievement in senior secondary school physics. The research design adopted for the study was descriptive survey. The sample consisted of nine hundred students who were randomly chosen and fifty Physics teachers who were purposively selected from forty five senior secondary schools in the south western region of Nigeria. Three instruments were used for the collection of data for the study. They designed questionnaire tagged "Physics Laboratory Equipment Questionnaire" (PLEQ) with reliability of 0.72, a checklist of Physics equipment and Physics Achievement Test (PAT) to measure students' achievement. The results showed that the optimal utilization of physics laboratory equipment is effective in the teaching of Physics. The federal schools had the maximum adequately utilized PLE and had the highest

mean score, followed by the private schools while the public schools with the minimum available equipment and least utilization capacity had the minimum mean score. The study concluded that science laboratory with adequate equipment is a critical variable in determining the quality of output from senior secondary school physics.

METHODOLOGY

Descriptive survey research design was adopted for the study. Descriptive survey design according to Nworgu (2006), is the one in which a group of people is studied by collecting and analysing data from few people, considered to be representative of the entire group. The author further stated that questionnaire, test or interview could be used to collect data in survey design. The design was considered appropriate for this study because questionnaire was used to obtain data from students of physics in the area of the study. The area of study is Ebonyi state in southeast Nigeria. The state has many senior secondary schools in both urban and rural settings with the primary target of ensuring access to quality secondary education by every child of school age. The population of the study is 207. According to the official record from the Planning, Research and Statistics of the secondary education board of Ebonyi state (2015) there are 49 of teachers of physics in urban schools and 178 in rural schools. Multi stage sampling techniques were used in choosing 100 respondents for the study. Firstly, random sampling technique by balloting was used draw a sample for the schools out of the three educational zones of the state. Secondly, simple random sampling by balloting was used to select ten local government areas from the state. Thirdly, simple random sampling technique was used to select 10 teachers of physics in each of the 10 local government areas making a total of 100 respondents. The Instrument for data collection was a structured questionnaire called 'Physics Practical Work Questionnaire' (PPWQ). The questionnaire items were generated based on the information gathered from the review of related literature. The questionnaire was made of part one, to solicit information on the personal data of the respondents while part two was structured into a cluster of 15 items: Each questionnaire item is assigned a four point scale of: Strongly Agree (SA); Agree (A); Disagree (D); Strongly Disagree (SD), with the corresponding values of 4, 3, 2 and 1 respectively. The instrument was firstly validated by two (2) experts; one from Measurement and Evaluation, Ebonyi State University, Abakaliki and the other from the department of Science Education, University of Nigeria, Nsukka. The validators were given a copy of the questionnaire for appropriate vetting, validation and suggestions. Their respective suggestions were incorporated in the production of the final questionnaire. The Chrombach's Alpha coefficient method was used to determine the reliability of the instrument. It was obtained by administering a single test to 20 selected teachers of physics in some selected senior secondary schools in Ikom local government of Cross River state, Nigeria. The choice of schools in the state is because they were in another geopolitical zone of the country. The data obtained from the administration of the questionnaire were analysed by finding the variance of each item of the questionnaire and the variance of the total number of items in each section of the questionnaire. The variances were used to calculate the alpha coefficient of the questionnaire. The result is a coefficient of 0.88. This value represents the reliability coefficient of the questionnaire. The researchers involved five research assistants from senior secondary schools within the area selected for the study. These research assistants were trained to assist in the administration of the questionnaire to the teachers of physics. One hundred (100) copies of the questionnaire

were administered and subsequently retrieved. Data collected were analysed using weighted mean and standard deviation to answer the one research question and t-test to test the null hypothesis at 0.05 level of significant. Four response options of Strongly Agree (SA), Agree (A), Strongly Disagree (SD), and Disagree (D) were posed for the respondents for each item. Each of the items was assigned a value, thus: SA = 4, A = 3, SD = 2 and D = 1. This produced a cut of point of 2.50. Any mean of 2.50 and above was accepted and rejected when below that value. The hypotheses were tested at 0.05 level of significance.

PRESENTATION AND ANALYSIS OF DATA

Research Question

What are the factors affecting quality and effective practical work in senior secondary school physics in Ebonyi state of Nigeria?

Table 1. Mean responses of teachers of physics from Ebonyi states' senior secondary schools on factors affecting quality and effective practical work in senior secondary school physics in the state.

s/n	Item statement	SA	A	D	SD	Total	Mean (X)	Standard Deviation(SD)	Decision
1	Non-availability of laboratory and equipment	336	33	6	2	377	3.77	1.00	Accepted
2	Inadequate laboratory materials	80	129	68	3	280	2.80	1.25	Accepted
3	Inadequate space for practical in laboratory	88	129	54	8	279	2.79	1.11	Accepted
4	Insufficient number of competent teachers	152	150	12	6	320	3.20	1.16	Accepted
5	Poor motivation of teachers	296	62	8	1	368	3.68	1.07	Accepted
6	Poor knowledge of practical work content	188	138	6	4	336	3.36	1.09	Accepted
7	Insufficient time allotted to practical work	112	150	30	7	299	2.99	0.44	Accepted
8	Lack of proper supervision	160	36	28	34	258	2.58	0.51	Accepted
9	Poor teaching methods	100	165	32	3	300	3.00	0.62	Accepted
10	Poor understanding of educational reform and its implementation by institutions	152	132	32	2	318	3.18	0.99	Accepted

11	Insufficient funds	328	36	8	2	374	3.74	1.04	Accepted
12	Power supply problem	84	117	38	23	262	2.62	0.92	Accepted
13	Lack of seriousness by the teachers and students	240	87	16	3	346	3.46	1.20	Accepted
14	Lack of quality textbooks	72	189	36	1	298	2.98	0.91	Accepted
15	Inadequate exposure of teachers of physics on the latest innovations in teaching and learning.	156	132	16	9	313	3.13	1.02	Accepted

The data presented in Table 1 revealed that the 15 items in the table had their mean values ranging from 2.58 to 3.77. This means that each of the mean value is above the cut-off point of 2.50, indicating that they are factors affecting quality and effective practical work in senior secondary school physics in Ebonyi state of Nigeria. The standard deviation of the items ranged from 0.44 to 1.25. This means that each of the standard deviations is below 1.96. It therefore shows that the respondents were not too far from the mean and they were close to one another in their responses.

Hypothesis H_O:

There is no significant difference in mean responses of teachers of physics from rural and urban schools of Ebonyi states on the factors affecting quality and effective practical work in senior secondary school physics in the state. The data for testing the hypothesis are presented in Table 2.

Table 2. T-test analysis of the responses of two groups of respondents (teachers of physics from urban and rural senior secondary schools of Ebonyi state) on the factors affecting quality and effective practical work in senior secondary school physics in the state

s/n	Item statement	Physics from urban areas of Ebonyi state N = 50		Physics from rural areas of Ebonyi state N = 50		t-cal	t-tab	Remark
		X_1	S_1^2	X_2	S_2^2			
1	Non-availability of laboratory and equipment	3.00	0.49	3.56	0.44	-1.59	1.96	Not significant
2	Inadequate laboratory materials	3.10	0.66	3.46	0.50	-4.77	1.96	Not significant
3	Inadequate space for practical in laboratory	3.74	0.97	3.14	0.95	-2.97	1.96	Not significant
4	Insufficient number of	3.71	0.46	3.69	0.46	0.40	1.96	Not

	competent teachers							significant
5	Poor motivation of teachers	3.27	0.99	3.44	0.87	-1.96	1.96	Not significant
6	Poor knowledge of practical work content	3.00	0.92	2.91	0.83	0.70	1.96	Not significant
7	Insufficient time allotted to practical work	3.19	1.09	3.28	0.86	-0.70	1.96	Not significant
8	Lack of proper supervision	2.66	1.08	3.06	0.72	-3.52	1.96	Not significant
9	Poor teaching methods	3.59	0.50	3.40	0.49	-2.96	1.96	Not significant
10	Poor understanding of educational reform and its implementation by institutions	3.14	0.79	3.02	0.95	1.06	1.96	Not significant
11	Insufficient funds	2.96	0.84	3.17	0.38	-2.86	1.96	Not significant
12	Power supply problem	3.26	0.70	3.31	0.47	-0.33	1.96	Not significant
13	Lack of seriousness by the teachers and students	3.41	0.69	3.36	0.46	0.13	1.96	Not significant
14	Lack of quality textbooks	3.29	0.74	3.54	0.48	-2.80	1.96	Not significant
15	Inadequate exposure of teachers of physics on the latest innovations in teaching and learning.	3.35	0.83	3.48	0.47	-1.60	1.96	Not significant

df = 99

The data presented in Table 2 revealed that each of the 15 items in the table had a calculated t-value less than the table value of 1.96 (two tailed test) at 0.05 significance and 99 degrees of freedom. This indicates that there was no significant difference in the mean ratings of the responses of the two groups of respondents (teachers of physics at schools from both urban and rural areas of Ebonyi state) on factors affecting quality and effective practical work in senior secondary school physics in Ebonyi state of Nigeria. With this result the null hypotheses of no significant difference were upheld for the 15 items.

RESULTS

The following findings emerged from the study based on the research question answered and hypothesis tested. The respondents agreed that for there to be quality and effective practical work in the senior secondary school physics, the following factors should be addressed.

- Non-availability of laboratory and equipment
- Inadequate laboratory materials
- Inadequate spaces for practical in laboratory
- Insufficient number of competent teachers
- Poor motivation of teachers
- Poor knowledge of practical work content
- Insufficient time allotted to practical works
- Lack of proper supervision
- Poor teaching methods
- Poor understanding of educational reform and its implementation by institutions
- Insufficient funds
- Power supply problem
- Lack of seriousness by teachers and students
- Lack of quality textbooks
- Inadequate exposure of teachers of physics to the latest innovations in teaching and learning

Finding on Hypothesis

The finding of the hypothesis tested revealed that there is no significant difference in the mean ratings on the responses of teachers of physics from both urban and rural senior secondary schools in Ebonyi state on the hypothesis tested with the corresponding items which are factors affecting quality and effective practical work in the senior secondary school physics in the state.

DISCUSSION OF FINDINGS

The findings of the study in the research question show that all the items presented were all accepted as the factors affecting quality and effective practical work in senior secondary school physics in Ebonyi state of Nigeria. The findings show that the factors include: Non-availability of laboratory and equipment, inadequate laboratory materials, inadequate space for practical in laboratory, insufficient number of competent teachers, poor motivation of teachers, poor knowledge of practical work content, insufficient time allotted to practical work, lack of proper supervision, poor teaching methods and poor understanding of educational reform and its implementation by institutions. Others include insufficient funds, power supply problem, lack of seriousness by teachers and students and lack of quality

textbooks. The findings are in agreement with Jegede and Adebayo (2013), who discovered that the fundamental problems militating against the teaching and learning of physics in Nigeria included curriculum content, teaching methods, quality of teachers and negative attitudes of students. The findings also agree with Olufunke (2012), who discovered that science laboratory with adequate equipment was a critical variable in determining the quality of output from senior secondary school physics. The findings equally agree with the discoveries of Adeyemo (2012) and Onah and Ugwu (2010) whose findings indicate that teachers supply and laboratory facilities have strong and positive influence on students' achievement in senior secondary school physics. The views, contributions and findings of the authors cited above have helped to justify the findings of the study.

Conclusion

Physics is a fundamental science that forms the basis for the development of technology, engineering and other allied areas. The level of overall development of any nation hinges on its scientific and technological advancement, hence accordingly, FGN (2008) noted that every student should be given an opportunity to acquire its concepts, principles and skills. More so, the senior secondary school physics curriculum has been developed to be relevant, appropriate and current in the rapidly changing world moderated by information and communication technology(NERDC; 2008). As a subject, the objective of senior secondary school physics is to ensure that students develop interest in it and choose it as a profession or choose others professions which require physics. This objective has not been achieved because most students shy away from the subject because it has been made too abstract through lack of quality and effective practical work. To make students choose and progress in this subject and put the nation on a path of sustainable scientific and technological development there is the need to address the institutional factors identified in this study. Making contribution to this direction the study identified the institutional factors affecting quality and effective practical work in the subject in the senior secondary schools in Ebonyi state of Nigeria. This if addressed by the relevant stakeholders could enhance a better understanding of the subject. The study therefore made the following contributions to knowledge;

- It has provided information to the management of senior secondary schools at the various levels of government on the institutional factors that should be provided or enhanced in schools for a better study of physics.

- The study has provided information that could be used by non-governmental organizations and development partner agencies interested in the provision of facilities for the implementation of science-based programs in our secondary schools. This is because they will use the findings to identify the various areas of attention and intervention.

- The study provided information which Ebonyi and other state states governments in Nigeria can use to develop workshop materials for training of teachers on improvisation in teaching and learning of physics at senior secondary school level.

- The study also provided information which the school administrators and proprietors could use to solve problems affecting quality and effective practical work in physics.

Recommendations for Improvement

Based on the findings of the study, the following recommendations are made.

- That the federal ministry of education in collaboration with the federal ministry of science and technology and other relevant agencies should address the identified factors so that science and technology would be its pride of place in the South East.

- That the different state governments in South East Nigeria should address the identified factors so that quality and effective teaching of physics practical would be ensured in the zone.

- That Parent Teachers Association (PTA) of schools in South East Nigeria should contribute resources for the purchase of needed facilities for the teaching of physics practical.

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