Impact of Practical Work in the Teaching of Physics in Secondary Schools in Rivers State

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Abstract
This study examined the impact of practical work in the teaching of physics in secondary schools in Rivers State. The simple size used for the study was 20 secondary school academic staffs (10 physics teachers & 10 laboratory instructors) randomly selected from ten (10) secondary schools in Port Harcourt Local Government. Four (4) research questions and three (3) null hypotheses were formulated to guide the study. Data were collected from respondents using sets of questionnaires structured in 4 point rating scale of agreement. The data were analyzed using mean and standard deviation. The finding shows that the respondents perceived physics practical work as an activity that helps teachers/students master the content through investigations and observations, promotes teachers/students understanding of the topics better. It also shows that practical physics makes scientific phenomena more real, has great potential in enhancing social interactions that can contribute positively to developing attitudes cognition in teachers. The findings also show that the constraints hindering effectiveness of practical work in physics include quality of instruction use in the laboratory, inadequate and antiquated facilities, half-baked teachers/instructors, non-availability of laboratory and equipment's among others. The study recommended that physics teachers should be professionals and holders of B.Sc.Ed in physics, every school should have well equipped physics laboratory, teachers should be adequately sensitized on the importance of physics practical, Government should make available Instructional aides, also regular supervision should be carried out in schools to ensure practical work is implemented.

Key words: *Impact, Practical, work, Laboratory, Physics, Teaching*

Introduction

One of the unique features of science education is that it involves practical work-activities in which the students manipulate and observe real object and materials (Abrahams and Miller, 2008). Practical work is very essential to the effective teaching of physics in senior secondary schools. Several studies have documented the statues of practical works in the teaching of science for more than a century (Hofstein and lunetta, 2004). Practical work experience has long been recognized as distinctive and central in the science curriculum. It is an activity–oriented method of teaching carried out by an individual or group of students for the purpose of engaging in personal observation of products, processes or event through actual experience. Physics is generally regarded as the nucleus of all technology. This simply means that physics controls all forms of technology. It also affirms that behind every technology, there is physics. At senior secondary school level, physics is defined as a branch of science that deals with matter, energy, their relationship and their measurements. The teaching method that can be used by teacher in effective teaching of physics in senior secondary schools is practical method. Practical work can be planned experiment, observation, specimen collection and even field work carried out during or after a physics lesson. According to Opong (1981) on way of

differentiating a scientist from a non-scientist is from experimentation. Hence Abdullahi (1982) defines experiment as operations or procedure used for the purpose of testing a supposition, confirming the known and discovering the unknown. In discovering the unknown, new theories are involved hence experimentation and theory are inter-dependent; each nourishing the other. According to Solomon (1980) "science simply belongs to the laboratory as naturally as cooking belongs to the kitchen and gardening to garden'' these portray the importance of practical work in school laboratories. Experiment is outstanding feature of practical work; it helps to prepare the mind to think creatively, rationally and objectively without bias because science by its nature deals with truth. Any statement made has to be tested to confirm its validity and reliability. Physics teachers should try to inculcate this idea of objectivity into their students. If students are allowed to collect specimen by themselves, it can bring about increased motivation and meaningful learning, student tends to understand better during practical class that they did themselves. In essence, it aids comprehension.

According to Dikmenli (2009), the main purpose of laboratory work in science education is to provide students with the conceptual and theoretical knowledge to assist them learn specific concepts and scientific methods to understand the nature of science. Ndu (1980) stated that practical work is regarded as any learning experience which involves student participation in activities such as observing, counting, measuring, experimenting, recording and carrying out fieldwork.

Therefore, in this study physics practical work is referred to by the researcher as the process of learning through which students are engaged in the learning process with the use of apparatus for the purpose of observation, measurement and understanding of what was theoretically taught in class. The professional knowledge, skills, and dispositions of physics teachers should be grounded in what the physics students will need to know and be able to do in order to contribute meaningfully to life in a democratic society. The physics teacher's knowledge base consists of three components: content knowledge, pedagogical knowledge, and pedagogical content knowledge (Etkina, 2005). Content knowledge is information of the discipline itself, and includes such things as practical methods. There is considerable research that indicates greater student gains in learning that are associated with teachers' knowledge about the subject content (Darling-Hammond, 2000). Ideally, the teacher would have learned basic content knowledge through methods of inquiry thereby acquiring practical knowledge. The teacher should have had an opportunity to experience the processes of scientific investigation: observing, asking questions, defining a problem; hypothesizing from an evidence base; making predictions; creating an experiment; identifying and controlling variables; collecting, graphically representing, and interpreting experimental data; conducting error analyses; drawing inferences and conclusions from data; and communicating results.

The value of practical work has long been recognized at the secondary school level. Many teachers acknowledge the value of learning by doing rather than theory only. (Driver and Braund, 2002). According to Hodson (1990) it is advisable that students should be prepared with mastery of the skills required for practical work so that they will be ready for assessment. Hodson (1996) further added that in practical work the candidate performs certain activities in order to discover something as yet unknown, to test a hypothesis or to check an already known fact. In order to perform these activities, the candidate has to learn the skills required for practical work, which includes preparing and performing experiments and processing the results obtained. Woolnough and Allsop (2001) noted that many science teachers recognized the importance of practical work. They believed that students should have first-hand practical experience in laboratories in order to acquire skills in handling apparatus, to measure and to

illustrate concepts and principles. Having firsthand information will allow students to apply the skills acquired during practical work when they become scientists in future. Physics, like religion is a search for truth. Hence to a student physics should be as sacred and as pious as the place of worship to a devotee. In fact physics study enables young minds to equip themselves for something higher and noble as search for truth and unrevealing the mysteries of nature. Demonstration of experiment is important for understanding the principles of physics. However, performing experiments by one's own hand is far more important because it involves learning by doing. It is necessary to emphasize that for a systematic and scientific training of young minds, a genuine laboratory practice is a must. According to educational psychologists the attitude of the student plays an important role in his systematic and scientific training. Science is a great human expertise. Open mindedness, curiosity, collection of data, demand for verification and proofs statistical reasoning, suspended judgments, acceptance of warranted conclusion and willingness to change over opinion in the light of new evidence are the ferments which characterize the scientific enterprise.

Appropriate practical work can be effective in helping teachers construct their knowledge, develop logical and inquiry-skills, problem-solving abilities, and can also assist in the development of manipulative and observational skills. Physics practical has a great potential in promoting positive attitudes and in providing students with opportunities to develop skills. In this respect the science laboratory is a unique learning environment as it would provide science teachers with opportunities to vary their instructional techniques. Ahiakwo (2002) suggested that practical works as a unique social setting has great potential in enhancing social interactions that can contribute positively to developing attitudes cognition in students.
Nzewi (2008) asserted that practical activities can be regarded as a strategy that could be adopted to make the task of a teacher more real to the student as oppressed to abstract on theoretical presentation of facts, principle and concept of subject matters. It is of important that the use of practical approach to the teaching of physics should be implemented in schools if we hope to produce students that will be able to acquire the necessary knowledge, skills and competence needed to meet the scientific and technological demands of the nation.

A study by Owolabi (2004) revealed that the performance of Nigeria students in ordinary level physics was generally poor. Jegede, Okota & Eniayeju (1992) reported factors responsible for poor implementation of practical work in physics as; poor laboratory facilities, inadequate number of learning facilities among others.
Physics as a science subject requires trained technicians and laboratory attendant (instructors). In many school due to lack of these technicians and attendants, the teaching of physics have been based largely on the expository strategy of teaching which encourage rote (memorization) of factual details with minimum emphasis on practical.

Today the students perform experiments for the sake of marks and teachers have failed to realize that ''practical work'' can aid them to effectively carry out their lessons. As a result of this, students at the senior secondary are not able to observe and draw inferences from their observation, tackle problems scientifically and even handle simple apparatus to verify principle so as to aid comprehension. This has led to student poor performance in physics practical leading to their failure in physics examinations. This study therefore is to examine impact of practical work in the teaching of physics in senior secondary schools.

Purpose of the Study
The main purpose of this study is to examine the impact of practical work in the teaching of physics in senior secondary schools. Specifically, this study intends to:

1) Examine perceptions of physics teachers and physics practical instructors towards practical work in senior secondary schools.
2) Determine the extent practical work enhance teaching of physics in senior secondary schools.
3) Examine the constraints hindering the effectiveness of practical work in physics.
4) Ascertain the strategies to improve physics practical work in senior secondary schools.

Research Questions

1) What are the perceptions of physics teachers and instructors towards physics practical work in secondary schools?
2) To what extent does physics practical work enhance the teaching of physics in senior secondary schools?
3) What are the constraints hindering effectiveness of physics practical in senior secondary schools?
4) What are the strategies that could improve practical work in physics secondary schools?

Hypothesis:

- There is no significant difference in the mean responses of physics teachers and practical physics instructors on their perceptions towards physics practical work.
- There is no significant difference in the mean responses of physics teachers and instructors on the extent practical work enhance the teaching of physics in secondary schools.
- There is no significant difference in the mean responses of physics teachers and practical physics instructors on the constraints hindering effectiveness of practical work in physics.

Methodology

The study employed a descriptive survey design to seek the opinion of the respondents on impact of practical work in the teaching of physics in secondary schools in Port Harcourt local Government Area, Rivers State. The population of the study comprised all physics teachers and laboratory instructors in public secondary schools in Port Harcourt local government area of Rivers State. The sample size was twenty (20) physical teachers and instructors. (1 physical teacher and 1 instructor each from 10 randomly selected schools). A well-structured questionnaire designed in 4 point rating scale of agreement was used for data collection. The instrument was tested using Cronbach Alpha reliability coefficient and it was found to be reliable at 0.82. Data collected was analyzed using mean and standard deviation, with an acceptance mean value of ≥2.50 while t-test statistical tool was used to test the hypotheses at 0.05% level of significance for independent t-test

Results and Discussion of Findings

Research Question 1: What are the perceptions of physics teachers and instructors towards practical work in physics?

Table 1: Perceptions of physics teachers and instructors towards practical work in physics

		Teachers N=10			Instructors N=10		
S/N	**Statements**	**X**	**S.D**	**Decision**	**X**	**S.D**	**Decision**
1.	Practical work in physics helps slow learners understands the content better; master the content through investigations and observations.	3.00	1.05	**Agreed**	3.20	1.03	**Agreed**
2	Much more is learned in student's experiments than teacher demonstrations.	3.40	0.96	**Agreed**	3.20	0.63	**Agreed**
3	Practical work proves theory in physics, and makes physics an interesting subject.	2.80	1.13	**Agreed**	3.40	0.96	**Agreed**
4	Performing practical work in physics promotes learners understanding of the topics better, and stimulates interest in the subject.	3.30	0.82	**Agreed**	2.80	0.91	**Agreed**
5	The teacher does not have relevant instructional materials for practical teaching of physics.	2.90	1.00	**Agreed**	2.90	1.19	**Agreed**
6	The time allotted for the subject on the time-table is too small.	3.20	0.78	**Agreed**	2.90	1.00	**Agreed**
7	Develop learners' skills on handling and organizing apparatus and materials.	2.70	1.05	**Agreed**	3.70	0.48	**Agreed**
8	Practical work in physics yield better results in physics and prepare learners to answer questions in paper 3 at the national level.	3.00	1.05	**Agreed**	3.10	1.00	**Agreed**
	Grand Mean & S.D	**3.03**	**0.98**		**3.15**	**0.90**	

Field work 2018

The findings in research question 1 show the perceptions of physics teacher and laboratory instructors towards practical work in physics. It shows that the respondents perceive physics practical work as an activity that: helps slow learners understands the content better; master the content through investigations and observations (3.00 & 3.20), much more is learned in student's experiments than teacher demonstrations (3.40 & 3.20), proves theory in physics, and make physics an interesting subject (2.80 & 3.40), promotes learners understanding of the topics better, and stimulates interest in the subject (3.30 & 2.80), develop learners' skills on handling and organizing apparatus and materials (2.70 & 3.70) and yield better results in physics and prepare learners to answer questions in paper 3 at the national level (3.00 & 3.10). These findings were in agreement with SCORE (2007) who reported that practical work demonstrate theoretical ideas, train learners on how to do and use various instruments in the laboratories. The findings also were in line with Toplis, & Allen (2012) who opined that practical work enables students to do science rather than merely learning about it.

Research Question 2: To what extent does practical work enhance the teaching of physics?

Table 2: Extent practical work enhance the teaching of physics

		Teacher N=10			Instructors N=10		
	Statements	**Mean**	**S.D**	**Decision**	**Mean**	**S.D**	**Decision**
1.	Practical work enables the teachers to produce students that will be able to acquire the necessary knowledge.	2.80	1.13	**High Extent**	3.30	0.82	**High Extent**
2	Much more is learned in students' experiments than teacher demonstrations.	2.90	1.00	**High Extent**	3.40	0.69	**High Extent**
3	Physics practical work helps teachers and students in other areas of sciences.	3.10	1.00	**High Extent**	2.80	1.13	**High Extent**
4	It enhances students' skills and competence needed to meet the scientific and technological demands of the nation.	2.90	0.73	**High Extent**	3.00	0.94	**High Extent**
5	Practical work in Physics encourages students' accurate observation and description.	3.10	1.00	**High Extent**	3.20	0.78	**High Extent**
6	It helps to inculcate scientific reasoning among teachers and students.	3.30	0.82	**High Extent**	3.40	0.69	**High Extent**
7	It makes scientific phenomena more real.	3.50	0.70	**High Extent**	3.30	1.05	**High Extent**
8	Practical work on physics helps to arouse and maintain teachers/students' interest in physics.	2.90	0.87	**High Extent**	3.30	0.67	**High Extent**
9	Makes the task of a teacher more real to the students as oppressed to abstract on theoretical presentation of facts, principle and concept of subject matters	2.90	1.00	**High Extent**	3.10	1.10	**High Extent**
10	Practical work has great potential in enhancing social interactions that can contribute positively to developing attitudes cognition in teachers.	3.10	0.87	**High Extent**	3.40	0.84	**High Extent**
	Grand Mean & S.D	**3.05**	**0.91**		**3.22**	**1.07**	

Field work 2018

The findings of the study in research question 2 shows that practical work enables the teachers to produce students that will be able to acquire the necessary knowledge (2.80 & 3.30), much is learned in students experiments than teacher demonstrations (2.90 & 3.40), helps teachers and students in other areas of sciences (3.10 & 2.80), enhances students' skills and competence needed to meet the scientific and technological demands of the nation (2.90 & 3.00), encourages students' accurate observation and description (3.10 & 3.20), helps to inculcate scientific reasoning among teachers and students (3.30 & 3.40), It makes scientific phenomena more real (3.50 & 3.30) and Practical work has great potential in enhancing social interactions

that can contribute positively to developing attitudes cognition in teachers (3.10 & 3.40). These findings were in agreement with Vilaythong and Popou (2008) who stated that practical activities enhance the understanding of physics theory and phenomena. The findings also relate with Nzewi (2008) opined that practical activities can be regarded as a strategy that could be adopted to make the task of a teacher more real. Also, the finding agrees with Mustapha (2002) which state that practical physics provides learners with the opportunities to use scientific equipment to develop basic manipulative skills and practice inquiry activities and develop problem solving attitudes needed for future work in science.

Research Question 3: What are the constraints hindering effectiveness of practical work in physics?

Table 3: Constraints hindering effectiveness of practical work in physics

	Statements	**Teacher N=10**			**Instructors N=10**		
		Mean	**S.D**	**Decision**	**Mean**	**S.D**	**Decision**
1.	Quality of instruction use in the laboratory.	3.30	0.82	**Agreed**	3.60	0.69	**Agreed**
2	Inadequate and antiquated facilities	2.90	1.00	**Agreed**	3.20	0.78	**Agreed**
3	Negative attitudes of students towards physics.	2.80	1.22	**Agreed**	3.30	0.94	**Agreed**
4	Non-availability of laboratory and equipments.	3.20	1.03	**Agreed**	3.60	0.51	**Agreed**
5	Inadequate space for practical laboratory.	3.40	0.84	**Agreed**	3.00	1.24	**Agreed**
6	Insufficient number of competent teachers.	3.20	0.91	**Agreed**	3.10	1.00	**Agreed**
7	Lack of proper supervision.	3.20	0.78	**Agreed**	2.90	0.73	**Agreed**
8	Poor power supply.	3.50	0.97	**Agreed**	3.40	0.96	**Agreed**
9	Lack of seriousness by teachers and students.	3.10	1.10	**Agreed**	3.70	0.48	**Agreed**
10	Inadequate exposure of teachers and instructors of physics on the latest innovations in teaching of physics practical work.	3.50	0.52	**Agreed**	2.90	1.10	**Agreed**
	Grand Mean & S.D	**3.21**	**0.91**		**3.27**	**0.84**	

Field work 2018

The findings of the study in research question 3 shows that all the items presented were accepted as the constraints hindering effectiveness of practical work in physics. The finding shows that the constraints include: Quality of instruction use in the laboratory (3.30 & 3.60), Inadequate and antiquated facilities (2.90 & 3.20), half-baked instructors (2.80 & 3.30), non-availability of laboratory and equipment's (3.20 & 3.60), inadequate space for practical laboratory (3.40 & 3.00), insufficient number of competent teachers (3.20 & 3.10), Lack of proper supervision (3.20 & 2.90), Poor power supply (3.50 & 3.40) and Lack of seriousness by teachers and students (3.10 & 3.70) These findings are in agreement with Jegede and Adebayo

(2013) who stated that the fundamental constraints hindering practical work in physics include curriculum content, teaching method and quality of teachers. Also Adebayo (2013) indicated that the fear of mathematical skills involved and poor method of teaching greatly affects learners' interest to the study of physics. Adeyemo (2012), Onah and Ugwu (2010) indicated that that laboratory facilities and quality teachers supply have positive influence on the implementation of practical physics. Also the findings agreed with Olufunke (2012) who opined that physics laboratory with adequate equipment was a critical variable in determining the quality of output that will be produced.

Research Question 4: What are the strategies that could improve practical work in physics?
Table 4: Strategies to improve practical work in physics
Field work 2018

		Teachers N=10			Instructors N=10		
	Statements	**Mean**	**S.D**	**Decision**	**Mean**	**S.D**	**Decision**
1.	Physics teachers should be professionals and holders of B.Sc.Ed in physics.	3.10	1.00	**Agreed**	3.10	1.00	**Agreed**
2	Every school should have well equipped physics laboratory.	3.40	0.51	**Agreed**	2.90	1.19	**Agreed**
3	Repositioning teacher preparation institutions for qualitative physics teachers' production.	2.90	0.87	**Agreed**	3.00	1.05	**Agreed**
4	Secondary schools should be adequately funded.	3.20	0.78	**Agreed**	3.10	0.56	**Agreed**
5	Teachers should be adequately sensitized on the importance of physics as a subject.	3.00	0.94	**Agreed**	3.30	0.48	**Agreed**
6	Government should make available Instructional aids.	3.10	1.19	**Agreed**	3.30	1.05	**Agreed**
7	Teachers should be sound in concepts and pedagogy.	3.00	1.05	**Agreed**	2.90	1.28	**Agreed**
8	Physics teachers should be adequately motivated through improved working conditions.	3.20	1.03	**Agreed**	2.90	1.00	**Agreed**
9	Regular supervision should be carried out in schools to ensure practical work is implemented.	3.00	0.81	**Agreed**	3.00	1.03	**Agreed**
	Grand Mean & S.D	**3.10**	**0.90**		**3.05**	**0.96**	

Research Question 4 revealed that the respondents agreed that physics teachers should be professionals and holders of B.Sc.Ed in physics (3.10 & 3.10), every school should have well equipped physics laboratory (3.40 & 2.90), repositioning teacher preparation institutions for qualitative physics teachers' production (2.90 & 3.00), secondary schools should be adequately funded (3.20 & 3.10), teachers should be adequately sensitized on the importance of physics as a subject (3.00 & 3.30), Government should make available Instructional aides (3.10 & 3.30), Teachers should be sound in concepts and pedagogy (3.00 & 2.90), Physics teachers should be adequately motivated through improved working conditions (3.20 & 2.90) and Regular supervision should be carried out in schools to ensure practical work are implemented (3.00 & 3.00).

Table 5: t-test analysis on the mean responses of physics teachers and practical instructors on their perceptions towards practical work in physics.

Groups	Mean	STD	N	DF	Level of Sig.	t-cal	t-crit	Decision
Teachers	3.03	0.24	8	14	0.05	1.06	1.76	Accepted
Instructors	2.90	0.27	8					

Table 5 shows that the teachers' mean and standard deviation scores were 3.03 and 0.24 respectively, while instructors' mean and standard deviation scores were 2.90 and 0.27 respectively. The t-cal value was 1.06, while the t-crit was 1.76 at 0.05 level of significance for independent t-test. This result shows that t-cal was less than t-crit, which means the null hypothesis was accepted. Thus, there is no significant difference in the mean responses of physics teachers and practical instructors on their perceptions towards practical work in physics.

Table 6: t-test on the mean responses of physics teachers and instructors on the extent practical work enhance the teaching of physics.

Groups	Mean	SD	N	DF	Level of Sig.	t-cal	t-crit	Decision
Teachers	3.05	0.21	10	18	0.05	-1.82	1.73	Accepted
Instructors	3.22	0.19	10					

Result in table 6 shows that teachers' mean and standard deviation scores of 3.05 and 0.21 while instructors' mean and standard deviation scores was 3.22 and 0.19 respectively. The t-cal value of -1.82 was less than the t-crit value of 1.76 at 0.05 level of significance for independent t-test. Therefore, the null hypothesis of no significant differences in the mean responses of physics teachers and instructors on the extent practical work enhance the teaching of physics was accepted.

Table 7: t-test on the mean responses of physics teachers and practical physics instructors on the constraints hindering effectiveness of practical work in physics.

Groups	Mean	SD	N	DF	Level of Sig.	t-cal	t-crit	Decision
Teachers	3.18	0.23	10	18	0.05	0.74	1.73	Accepted
Instructors	3.27	0.29	10					

Result in table 7 shows that teachers' have mean and standard deviation scores of 3.18 and 0.23 while instructors' have mean and standard deviation scores of 3.27 and 0.29 respectively. The t-cal value of 0.74 was less than the t-crit value of 1.73 at 0.05 level of significance for independent t-test. Therefore, the null hypothesis of no significant differences in the mean

responses of physics teachers and practical physics instructors on the constraints hindering effectiveness of practical work in physics was accepted.

Summary and Conclusion

Based on the findings, the study concludes that much more is learned in student's experiments than teacher demonstrations. Practical work in physics helps slow learners understands the content better, it yield better results in physics and prepare learners to answer questions in paper 3 at the national level.

The study also conclude that practical work enables the teachers to produce students that will be able to acquire the necessary knowledge, it enhances students' skills and competence needed to meet the scientific and technological demands of the nation. It helps to inculcate scientific reasoning among teachers and students and also makes scientific phenomena more real.

Finally, the study also concludes that quality of instruction use in the laboratory, Inadequate and antiquated facilities, insufficient numbers of competent teachers among other are the constraints to the effectiveness of practical physics.

Recommendations

- Physics teachers should be professionals and holders of B.Sc.Ed in physics.
- Every school should have well equipped physics laboratory.
- Teachers should be adequately sensitized on the importance of physics practical.
- Government should make available Instructional aides.
- Regular supervision should be carried out in schools to ensure practical work is implemented.

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