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Assessment of Professional Development and Effectiveness of Secondary School Physics Teachers in Rivers State

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ABSTRACT

This study examines the involvement of teachers' professional development in relation to their effectiveness in teaching physics at the secondary school level in Rivers State. Purposive sampling was utilized to select 8 schools in high and low performing local government areas of Rivers State. All 14 physics teachers and 248 physics students in the 8 schools participated in the study.A mixed methods research design was adopted for the study. The research instruments comprised questionnaires and semi-structured interviews for teachers and students. The study was guided by three research question.Descriptive statistics was utilised for quantitative data analysis alongside qualitative data coding and analysis. The study found that teachers' participation in Continuing Professional Development activities was low and recommended that teachers update their knowledge by regularly attending CPD programmes, workshops and seminars on current research studies for effective teaching and classroom practicesto improve their understanding and usage of available resources for the best classroom and learning experiences of students, and the use of appropriate resources for their lessons.

Keywords: Continuing Professional Development, Effectiveness, Physics, Teachers

Introduction

Teachers' professional development in areas of content, pedagogy, use of technology, assessment and feedback, lesson preparation and presentation are perceived as relevant to the quality and effectiveness of the teacher. In this section, relevant research findings in literature on the place and effect of teachers' continuing professional development has been reviewed to have a good understanding of current research findings, give focus to the study and adequate guidance to the discussion of findings on the subject for the present study.

The place and role of teachers as a valuable resource in the school as a system of educational activities cannot be overemphasized. In general, studies have shown that certain factors within the teacher's control significantly influence the academic attainment or progress of his pupils (Rivkin, Hanushek & Kain, 2005; Cox, 2015). Some of these factors according to Mcber (2000) are the teacher's teaching skills, his professional characteristics and the classroom climate which together accounted for "well over 30% of the variance in pupil progress" (p.9). Some of these skills in teaching and professional characteristics are developed in teacher training and re-training activities in organized Continuing Professional Development (CPD) programmes by relevant professional bodies and institutions.

Parents and sometimes, students in certain allowable circumstances use teacher quality differences among teachers to request for class placement with specific teachers (Rivkin, Hanushek & Kain, 2005). The teacher plays several roles in the context of the school system. Some of the roles of the teacher have been summarized by Cox (2015):

> "The role of a teacher is to help students apply concepts, such as math, English, and science through classroom instruction and presentations. Their role is also to prepare lessons, grade papers, manage the classroom, meet with parents, and work closely with school staff. Being a teacher is much more than just executing lesson plans, they also carry the role of a surrogate parent, disciplinarian, mentor, counsellor, book keeper, role model, planner and many more"

As can be seen, the teacher has very many roles from the stage of lesson preparation, selection of appropriate delivery techniques, lesson presentation and classroom management, to that of skills in effective assessment and feedback to pupils, parents and school authorities, not excluding some other roles that posit the teacher as a role model, counsellor, facilitator and even a surrogate parent. These enormous task bequeathed on the teacher demands

that the teacher is not only well trained or satisfy some basic Teacher Standards in his initial qualification process, but that the teacher whilst in service is prepared adequately with training and re-training programmes that would sufficiently support the teacher in demonstrating enhanced skills and knowledge development in those Teacher Standards that would enable him actualize his classroom roles and expectations effectively. Some scholars have advocated that teachers' continuing professional development if appropriately executed would improve teachers' quality of instruction, lesson delivery skills, subject content knowledge and confidence which could in turn result in school pupils obtaining higher academic attainments (Harwell, D'Amico, Stein &Gatti, 2000; Knapp, 2003; Richards & Farrell, 2005; Kunz, Nugent, Pedersen, DeChenne& Houston, 2013).

There is empirical evidence in literature that supports the positive effect of teachers' participation in continuing development on both the teacher's efficiency and pupils' academic attainment. For instance, Kunz *et al.,* (2013) investigated the differences between rural science teachers who received professional development in guided scientific inquiry and those who did not receive any form of professional development and reported that:

> "Teachers' pedagogical content knowledge (PCK) of guided science inquiry significantly increased from 34% correct before the summer portion of the guided science professional development institute (i.e., Summer Institute) to 58% correct immediately after the Summer Institute (p=.000). Similarly, teachers' scientific inquiry knowledge (SI) significantly increased from 69% correct prior to the
> Summer Institute to 80% correct immediately after the Institute (p=.002). The growth of teachers' classroom inquiry knowledge (CI) was not statistically significant (from 68% to 72% correct, p=.125)" (p.6).

The results above show that teachers' participation in professional development programmes significantly enhanced their pedagogical content knowledge (a measure of their instructional strategies) and scientific inquiry knowledge (a measure of teachers' knowledge of the nature of science and inquiry in science) with an improvement (from 68% to 72%) in the teachers' classroom inquiry knowledge which measured teachers' scientific questioning skills and abilities, priority to evidence and formulating explanations (Kunz, *et al.*, 2013). Similarly, the study by Yoon, Duncan, Lee, Scarloss& Shapley (2007) that reviewed studies on the effect of teacher professional development on students' attainment, reported that professional development of teachers enhances their skills and knowledge which ultimately bettered their classroom interaction and teaching skills. On the link between professional development of practicing teachers and students' attainment, Yoon *et al.* (2007) reported that:

> "Professional development affects student attainment through three steps. First, professional development enhances teacher knowledge and skills. Second, better knowledge and skills improve classroom teaching. Third, improved teaching raises student attainment. If one link is weak or missing, better student learning cannot be expected. If a teacher fails to apply new ideas from professional development to classroom instruction, for example, students will not benefit from the teacher's professional development" (p. 4).

Yoon *et al*. (2007) also reported studies which showed that "students would have increased their attainment by 21 percentile points if their teacher had received substantial professional development" (p.2) and that teachers who get involved in least amount of professional development of between 5 – 14 hours did not show any statistically significant effect on the attainment of their students.

The foregoing therefore underscores the necessity and importance of quality continuing professional development programmes for in-service teachers – A professional development programme that would expose and engage teachers with quality time and duration on subject content knowledge, pedagogy, classroom management, teacher standards, integrating information technology into subject content, improving students' critical thinking and inquiry skills and effective assessment and feedback techniques. Such an efficient and effective professional development programme would then not be a one-day, one-off programme if the much-desired goals of the programme must be achieved. On the criteria for a good quality teacher professional development programme, Yoon, *et al.* (2007), cited the No Child Left Behind (NCLB) Act of the United States which defined five criteria:

> "(1) It is sustained, intensive, and content focused—to have a positive and lasting impact on classroom instruction and teacher performance.
> (2)It is aligned with and directly related to state academic content standards, student attainment standards, and assessments.
> (3)It improves and increases teachers' knowledge of the subjects they teach.
> (4) It advances teachers' understanding of effective instructional strategies founded on scientifically based research.
> (5)It is regularly evaluated for effects on teacher effectiveness and student attainment" (p.1,2).

In the light of the NCLB Act, it is important to stress that the sort of professional development programme that would have a substantial impact both on the teacher and the school system, is one that is content-focused, aligned with established teacher standards, professionally useful to the teacher in terms of the enhancement of his skills and knowledge, sustained over time and is regularly appraised for its effectiveness. Considering the importance of teacher training and re-training, it is imperative that school administrators and policy makers conscientiously plan, encourage and support both

inexperienced and experienced teachers to get engaged with regular quality professional development programmes so as to enhance their knowledge and skills and improve the academic attainment of their students.

Teachers' professional development and teacher effectiveness

Teachers are important resource in the teaching and learning enterprise. According to Hanushek (2011), to influence students' attainment, teachers are the most important factors in the school system than any other measured variable of schools. Teachers' professional development and competence is related to the quality of instruction as one of the 9 productive factors of Walberg's educational theory. It is therefore very important that there are not just teachers in the classrooms, but that the teachers in the classrooms are those who are very highly qualified and are "worth their salt". There is research evidence that associates effectiveness with teacher-professional development. In the view of Wei, Darling-Hammond, Andree, Richardson &Orphanos (2009), "improving professional learning for educators is a crucial step in transforming schools and improving academic attainment". According to them, "to accomplish this, schools - with the support of school systems and state departments of education - need to make sure that professional learning is planned and organized to engage all teachers regularly and to benefit all students" (p. ii). This position assumes that if teachers are effectively trained professionally, then students they teach would 'benefit' from such quality of training in way of effective learning and better academic attainments. The National Center for Learning Disabilities, NCLD (2010), opined that the teachers' "understanding and mastery of pedagogy and subject matter, together with their ability to apply effective teaching practices, are the keys to learning for all students" (p.1). It further stated that "teacher performance and effectiveness must be measured with valid and reliable assessments of teacher knowledge and classroom performance that are linked to student learning" (p.2). It is therefore important that teachers receive good support from their employers for good classroom teaching practices that would ensure effective learning of students especially in science classrooms.

Considering the relevance of teacher professional development, the Questionnaire for Physics Teachers (QPT) contained an item that sought to capture teachers' participation in professional development activities in the past two years in the areas of physics content, physics pedagogy/instruction, physics curriculum, integrating Information Technology into physics, improving students' critical thinking or inquiry skills and physics assessment.

Purpose of the study

The main purpose of the study was to investigate the effects of physics teachers' participation in professional development activities on their effectiveness. Specifically, the study investigated:

1. The participation of physics teachers in professional development in the last two years
2. Teachers' use of computer and new technologies to facilitate their teaching
3. Students' use of technologies in physics classrooms

Research Questions

1. What is the level of physics teachers'participationin professional development in the last two years?
2. How often do physics teachers' use of computer and new technologies in facilitating their teaching?
3. What is the level of physics students' use of technologies in physics classrooms?

Methodology

The study adopted the mixed research design. Specifically, the descriptive and exploratory analysis method was employed for the study. Creswell (2012) explained that the mixed research design is a procedure employed for observation, data collection, analysis and the combination of both quantitative and qualitative research methods in a single study aimed at understanding the research problem. The study was conducted in Rivers State, Nigeria.The purposive sampling was utilized to select schools in the high and low performinglocal government areas of the state in physics having a boy, girl and co-educational school. Thisschool selection criteria is so adopted to capture the three school types – single sex boys, single sex girls and mixed, in the system. Based on the above criteria, eight schools from three out of the 23 Local Government Areas in the state were selected for the study. All 14 Physics teachers and 248 Physics students in the selected schools participated in the study.

The instruments developed for data collection were the Questionnaire for Physics Teachers (QPT), Questionnaire for PhysicsStudents (QPS), Interview Schedule for Physics Teachers (ISfT)and the Interview Schedule for Physics Students (ISfS). The QPTconsists of two sections that provide responses

toteachers' characteristics, qualification and activities in the schoolwhich have been identified in literature to have some effect to the teaching and learning of Physics (Williams, et al, 2003). The teachers were asked to response the 4-point scale closed ended questions related to their attendance of CPD and use of technologies for teaching following the scale of "A lot", "To some extent", "Very little" and "Not at all". The QPS is a 7-item structured instrument developed to obtain responses from the students about the school, students' experiences in physics classrooms, their perception about their physics teacher and their use of technologies in physics classroom for their learning. Students were asked to respond to the questions on a 5-point scale of Strongly Agree, Agree, Disagree, Strongly Disagree and Can't say.The ISfTwas made up of 9 questions and lasted between 45-60 minutes, while the ISfS composed of 8 questions lasted between 25-45minutes. All questions on the schedules (ISfT and ISfS) were consistent with the research questions and developed by the researcher from extensive search of the literature on possible school climate factors that could affect the teaching and learning of Physics in secondary schools. The response of the interview from the participants were recorded and transcribed for coding, while the thematic content analysis was used to determine common patterns across the data set for both teachers and students. All the instruments were validated by experts in Science Education. The reliability of the questionnaires was established using test retest and the Pearson Product moment correlation. The correlation coefficients obtained for the instruments were r = 0.891 for the QPS, r = 0.819 for the QPT. The p-values for all were less than 0.05 which implied that the correlation coefficients were statistically significant. The instruments were therefore considered reliable and used for the collection of data.

Results

Research Question one

What is the level of physics teachers' participation in professional development in the last two years?

The result of teachers' response is presented below.

Table 1 *Teachers' participation in professional development activities in the past 2 years*

	Areas of Teachers Participation in Professional Development					
Response	PD in Physics Content	PD in Physics pedagogy/ Instruction	PD in Physics curriculum	PD in Integrating information technology into physics	PD in Improving students' critical thinking or inquiry skills	PD in physics assessment
Yes	6 (42.9)	5 (35.7)	5 (38.5)	4 (28.6)	7 (50.0)	5 (38.5)
No	8 (57.1)	9 (64.3)	8 (61.5)	10 (71.4)	7 (50.0)	8 (61.5)
Total	14 (100)	14 (100)	13 (100)	14 (100)	14 (100)	13 (100)

Table 1 shows the participation of teachers in Continuing Professional development activities in the past two years. The Table reveals that apart from professionaldevelopment activities in 'improving students' critical thinking or inquiry skills' where 50% ofteachers say they have attended in the last 2 years; most teachers do not attend CPD trainings oractivities in theother areas as reflected in the Table with less than 50% of the teachersparticipating in professional development activities in those areas. The worst is in the area of'integrating information technology into physics' with only 28.6% of teachers saying they haveattended CPD activities in that area. Both teachers and students have expressed the lack ofcomputer facilities and utilization in their physics lessons.

Research Question two

How often do physics teachers' use of computer and new technologies in facilitating their teaching?

The response of Teachers on how often they use computer as a teaching or instructional tool is presented in Table 2.

Table 2 *Teachers' response on how often they use a computer and new technologies as teaching or Instructional tools*

Responses	**Frequency**	**Percent**	**Valid %**	**Cumulative %**
About half the lessons	0	0.0	0.0	0.0
Some lessons	1	7.1	7.1	7.1
Never	13	92.9	92.9	100.0
Total	14	100.0	100.0	

Results from Table 2 shows that 92.9% ofteachers say they "never use computer as a teaching or instructional tool" while only 7.1% agree that they use computer and new technologies in 'some lessons'

Research Question three

What is the level of physics students' use of technologies in physics classrooms?

Table 3 *Students' percentage response on use of technologies in physics classrooms*

	% response		
Response type	Use DVDs, Videos in physics lessons	Use computer simulations on Physics	We watch our teacher demonstrate physics on a computer
Every or almost every lesson	0.4	1.2	1.7
About half the Lesson	0.4	2.1	1.7
Some lessons	1.2	5.0	2.1
Never	98.0	91.7	94.5

Results from Table 3 show that that 98% of physics students responded that they have "Never' used DVD's and videos in their physics lessons. Also, 91.7% of the students revealed that computer simulations on physics have 'Never' been used in their physics lessons, while 94.5% of students said they have 'Never' watched their teacher demonstrate physics on the computer. The students' response also agrees with that of the teachers (see Table 2) on the use of computers in physics instructions. It is likely that the rare or non-use of such facilities and technologies in physics teaching and learning could hamper effective learning. The International comparison in physics attainment has shown that "students coming from theoretically more advanced countries perform worse than the average" (Esquembre, 2002:13). This again may explain the low performance of students in the Physics.

The poor attendance of physics teachers to professional development activities as shown above may have been as a result of the attitude and modus operandi of school administrators and managers on the organization of such programmes. Responding to an interview question on teachers' continuous professional development, as to whether or not physics teachers have enough training and retraining activities to enhance their effectiveness, a physics teacher in one of the schools had this to say:

> "Yes, I, most times I take it upon myself to enrol to upgrade my knowledge in teaching of physics especially the sciences. I take out part-time studies. Recently I just finished a programme with Niger Delta University to do my PG in Technical Education so as to give me more knowledge and more ground on how to teach the technical sciences…the Ministry do organise refresher courses, but not for all science teachers per say, they normally call the most senior schools… at times, in a region like this, they can just call for 2 or 3 teachers and which does not augur well for all the other schools. If the 2 or 3 teachers from the zone go, they will not come back to impart the same knowledge which they have acquired to the other teachers which were not privileged to be part of that workshop, so it is not a welcome idea" (B1T, 143-146, 151-156).

It is possible that the level of attendance of teachers to professional development programmes and activities, may improve if school authorities realize the need to fund the training and re-training of their teachers especially in areas of current research findings and proven innovative science teaching and learning approaches, which the teachers may employ for effective classroom teaching and learning activities. All science teachers are supposed to gain from such training programmes so that students they teach would also ultimately not be disadvantaged and would benefit from the wealth of experience, knowledge and skills teachers would gain from such professional development activities.

Discussion of findings

The finding of the present study aligns with those of Adeyemi andOlaleye (2010), Adeosun (2010) and Abubakar and Adebayo (2014) conducted in Nigeria and those of Nganji, KwemainandTaku (2010) and Amenyedzi, Lartey andDzomeku (2011) of schools in Cameron and Ghana respectively. For example, Adeyemi &Olaleye (2010) investigated the state of ICT availability and other related matters in secondary schools in Ekiti State, Nigeria and reported that the level of provision of ICT equipment in secondary schools was low. Similar findings in public schools have been reported in the south-south states of Delta and Edo and Lagos in the south-west of Nigeria. However, finding discordant with the present one was found by Adeyemo (2010) who investigated the impact of ICT on the teaching and learning of physics. His study involved two senior secondary schools from each of five educational districts out of the present six in Lagos State, Nigeria. He reported that all schools in his study were "equipped with electronic computer system connected to internet" (p.59). Although a study carried out in the same Lagos State (Adeosun, 2010) reported that schools in the state lacked

computers and ICT tools, it is difficult to have a true picture as both studies have their limitations that would have guided any reader to a fine conclusion. For instance, Adeyemo (2010) did not state the ownership of the schools that were involved in his study. Most studies have reported that public schools in Nigeria have poor state of infrastructure and funding behind federal government owned schools and private schools (Aduwa-Ogiegbaen&Iyamu, 2005; Bello, 2012). Similarly, it was also not clear how Adeosun (2010) selected his sample – the school types and the localities. Another possible explanation for the different reports could also be on the location of the schools that were selected for the studies. Some studies have reported that schools in the urban areas tend to be favoured with the provision of facilities for teaching and learning than schools located in the rural areas (See for instance, Adeyemi, 2008). The state of electricity supply in rural areas is especially poor with most rural communities without electricity and it is unlikely that public schools that are located in rural areas of the state would be equipped with electronic computer system that are connected to the internet.

Conclusion

The study has provided some insight into the state of science teaching and learning in Nigerian schools, status of resources for teaching and learning of science subjects in schools, quality of physics teachers, teaching strategies common among physics teachers in Nigeria, the nature of school climate in most schools and the state of teachers' participation in continuous professional development programmes. To undertake an in-depth study of the problem, a mixed method research design was adopted for the study with the use of questionnaires, interviews, classroom observations, attainment test and secondary data.

Implications of the study

The finding of this study indicates that physics teachers do not regularly attend continuing professional development programs. The implication here is that physics teachers may not be abreast of current research-informed teaching and learning strategies that would facilitate student learning. It is therefore important that policy makers make provisions for and fund the regular training and re-training of in-service teachers, and the inclusion of continuing professional development activities as mandatory career growth route for teachers in Nigeria. Furthermore, teachers could improve on their qualification by enrolling in in-service training and continuing professional development programmes on content and pedagogical areas to enhance their qualifications for better effectiveness, as there is good evidence in literature supporting a positive correlation between teachers' content and pedagogical knowledge and students' attainments.

Recommendations

Following the findings of the study, it is recommended that teachersupdate their knowledge by regularly attending CPD programmes, workshops and seminars on current research studies on effective teaching and classroom practices and the use of appropriate resources for their lessons. This is so as Vorsino (1992) averred that teachers' non-use of resources when available was as a result of their lack of adequate knowledge in scientific content and use of relevant laboratory resources. It is therefore hoped that teachers' attendance of Continuing Development Programmes on subject content, pedagogy and instrumentation may improve their understanding and usage of available resources for the best classroom and learning experiences of students.

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