



Teacher Quality Indicators as Correlates of Public Secondary School Physics Students' Achievement in Onitsha and Awka Educational Zones of Anambra State, Nigeria

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Authors' contributions

This work was carried out in collaboration between the both authors. Author UEE designed and supervised the running of the project, and revised the manuscript for important intellectual content. Author OCM managed the literature searches and performed the statistical analysis. Both authors read and approved the final manuscript.

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ABSTRACT

This study examined teacher quality indicators as correlate of physics students' achievement in Onitsha and Awka Educational zones of Anambra State. Fifty Physics teachers and 500 senior secondary two physics students were randomly selected from fifty schools in Onitsha and Awka educational zones of Anambra state, physics Achievement Test, Students' Questionnaire on Teacher-Student Relationship, Teacher's Classroom Observation Form, and Teacher's Demographic Form were used for data collection and were analyzed using multiple regressions. The results showed that combined teacher quality indicators (teacher's subject matter knowledge, teacher's qualification, teacher-student relationship, teacher's qualification and teacher's experience) have significant contributions to physics achievement ($F = 5.417, P < 0.05$). Relative

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contributions of pedagogical knowledge, Teacher-student relation, teacher's experience and Teacher's qualification to achievement, were not significant except subject matter knowledge ($\beta = 0.227$, $p < 0.05$) which was found to have significant relationship with Physics achievement. It was recommended that teachers should be given opportunities for continuous study in physics and other professional developments to improve their content knowledge.

Keywords: Teacher quality indicators; students' achievement in physics.

1. INTRODUCTION

Science and technology are instruments of development of any nation and Technology has become an indispensable culture in the world. This is due to the fact that the economic and political strength of any nation depend on her scientific and technological achievement [1,2]. It therefore, implies that for any meaningful national growth and development to be achieved, science and technology should play its role [3,4].

Developed world are able to achieve so much in science and technology because of their commitment to science education. Science is taught in Nigerian senior secondary schools as biology, chemistry and physics and physics is a branch of physical sciences that concerns mainly with matter in relation to energy [5]. [6] asserts that physics is a vehicle for achieving the long-term goals of science because it is instrumental to technological and socio-economic growth across the globe. The role of physics in the education of engineers, chemists and practitioners of other physical and biological sciences are enormous [7]. In spite of the importance of physics, students' performance in the subject at all levels of education has not been encouraging. [8,9] reported that students' performance at the senior secondary school level (high school) was not good enough and their position is supported by the West African Examination Council (WAEC) result for almost a decade now (2005-2014) which candidates that score credit and above fluctuates between 40% and 60% with the highest of 68.74 % in 2012. One may think that this result is not too bad but for a nation that aspires to move up the technological ladder definitely requires better performance in physics.

Physics teachers are the key factor to be considered when considering development of physics education in any nation. In Nigeria, science teaching including physics dated back to 1859 by the early missionaries when they established CM.S Grammar School, Lagos [10] and other schools later but it was not until 1908

with the passing of the Education Ordinance that some of the missionary schools were able to acquire science equipment for laboratory instruction and after then Kings College Lagos were able to offer physics to the standard of Cambridge University Senior Local E [11]. When the subject physics was introduced into the secondary school system, it was taught by foreigners because there were no indigenous experts. However, over the years before and after independence, the government has embarked on the production of physics teacher through the establishment of faculties of education in the Universities. University of Nigeria, Nsukka were the first to start a degree programme in Science Education followed by the other first generation universities in the country and this has continued since then.

Most Teacher Education first degree programmes in Nigeria are organized using the concurrent model where students simultaneously study one teaching subject and the ways of teaching that subject for a period of 4 years (though the National Universities Commission is proposing a 5 year programme now for teacher education) to obtain a B Sc Ed or B A Ed as the case may be. So the pre-service physics teacher takes physics courses from physics department of the University and Education courses from the Faculty of Education. He/she offers physics courses from 100 level to 400 level and these covers all areas of physics that prepares him/her to be able to teach any aspect of physics in the secondary school. However, it is expected that practicing teachers undergo professional development through self effort and government support which may depend on other factors like availability of funds even though it is the right of all teachers that are employed by the government.

Quality teachers have been recognized as indispensable human resource and indeed, one of the most important elements in the school system, more important than the quality of equipment and materials [12]. Several studies focus on teacher quality using categorization of

teacher characteristics. These studies provide descriptive lists attempting to identify the key elements of teacher quality [13,14] which include content knowledge, teaching skills, dispositions, lists of knowledge and skills on effective research [15]. Other skills also frequently identified in research are management and organizational skills, interpersonal skills such as communication, skills to work collaboratively, to guide and support learners, teaching skills in using stated objectives of learning, using instructional methods that foster critical thinking, involving students actively in learning, using innovative teaching methods and so on. Besides these studies, personal attitudes, values and ethical behavior of quality teaching such as being respectful, democratic, fair, caring, understanding, approachable, open-minded, having a sense of humor, autonomy and so on [16,17] are also part. [18] suggests that quality teachers are the key to enhancing learning at schools.

In order to act as a professional teacher, a teacher should have different kinds of knowledge, not only subject matter or content knowledge but also knowledge of how to support students' learning as mention earlier. Teacher qualities include the logical acts of teaching (defining, demonstrating, modeling, explaining and so on), psychological acts of teaching (caring, motivating, encouraging, rewarding, punishment, planning, evaluating and so on), and the moral acts of teaching (showing honesty, courage, tolerance, respectful, fairness and so on) [19]. Quality teachers teach students how to learn and help them to use the models of learning that will support the best academic, social, and personal growth. This is partly similar to what [20] states: For students to reach their potential, a quality teacher must pay more attention to the interplay between the science and art of teaching otherwise termed pedagogy. Teaching for meaningful learning entails teaching the content, skills and inculcating the right attitude [21].

Quality teachers are the critical determinant of students' achievement. A number of researchers have argued that teacher quality is a powerful predictor of students' performance. [22] argue that the single most important factor affecting student's achievement is teacher and the effect of teachers' quality on students' achievement are both additive and cumulative. They further contended that lower achieving students are most likely to benefit from increases in teacher

effectiveness. [23] argued that shortage of qualified teachers is responsible for the poor academic achievement observable among the students. [24] contends that measures of teacher quality are more strongly related to students' achievement than other kinds of educational investments such as reduced class size, overall spending on education and teacher's salaries. But which of these teacher quality indicators has what influence on students learning is what this study sought to establish. So these indicators will be considered one after the other.

Pedagogical knowledge of the teacher is one of the teacher quality indicators considered in this study. This is the teachers' deep knowledge about the methods of teaching and learning. The science of teaching, according to [25], is referred to as pedagogy. Several literature have revealed that pedagogical knowledge is an essential and critical element in determining teachers' success in teaching and learning processes in the classroom [26,27]. A study of [28] shows that combined variables of teacher quality and instructional strategies are correlated with achievements. [29] purports that lack of pedagogical skills and knowledge is a bigger threat to teacher quality than certification issues.

[28] conducted a study which examined the correlates between two independent variables of teacher quality and instructional strategy on students' performance in secondary school science in Ethiopia East and Ekwuani Local Government Area of Delta State. The result showed that the teacher quality and instructional strategy had positive significant relationship with achievement in science. According to [30] teachers with good mathematical pedagogical knowledge can break down mathematical knowledge into less polished and less abstract forms, thus making it accessible to students who are at different cognitive level. He further pointed out that teachers with good pedagogical knowledge understand where students may be struggling with learning the subject and should be able to present mathematical concept in a way that their students can comprehend each structure and avoid difficulties. How this teacher quality indicator relates to students achievement in physics is what this study sort to find out.

Teacher's subject matter knowledge is another teacher quality indicator. This is teacher's knowledge about the content to be learned or taught. The content to be covered in primary school science is different from the content to be

covered in an undergraduate course. [31] observed that teachers who have strong subject matter knowledge give details in their lesson, link the topic to other topics, throw questions to students, stray from the textbooks and promotes students' learning outcome. But [24] shows weak relationship between content knowledge and students learning.

Teachers-students relationship is another teacher quality indicator considered in this study. This means getting to know students as individuals as well as a group, getting to know them in terms of cultural background, intellectual profile, learning strength and academic potential as well as their interest outside the school and what they do for fun [32]. Several literature reveal that strong relationship exists between the instructor's involvement and students' achievement. Study of [33] on teacher-student relationship shows that, good relationship between teacher and students influence the students' outcomes positively. Again, [34] show that early teacher- student relationship affect early academic and social outcomes as well as future academic outcomes. [35] also shows that positive relationship with the teacher is important in supporting higher level of self-esteem, higher academic self-efficacy, academic achievement and more confidence in future employment outcomes. Studies of [36,37] reveal that positive teacher-student relationship enable students to feel safe and secure in their learning environments and provide scaffolding for important social academic skills. They maintained that teachers who support their students in the learning environment can positively impact their social and academic outcomes.

Teacher's teaching experience is another teacher quality indicator considered in this study and it is defined as the number of years a teacher has spent in the teaching service. [38] found that years of experience has a strong correlation with improved students' achievement. It is argued that prospective and experienced teachers' knowledge and beliefs serve as a filter through which their teaching take place [39]. A study conducted by [40] showed that level of experience has a significant influence on teaching effectiveness of the teachers and their students' achievement. Similarly, [41] found that teaching experience of teachers is significantly related to their teaching effectiveness and their students' achievement. The findings of [40] also showed a positive relationship between teacher experience and students' outcomes. However,

most of these studies are done outside the country so the researchers want to see if it will be the same in Nigeria.

Teacher qualification is another teacher quality indicator of note and it is the highest educational qualification the teacher has obtained. With the problem of shortage of qualified teachers of physics to teach the subject in secondary schools in the country, it is a common thing now to see many schools with no physics teacher and as a result you see teachers with any type of qualification teaching physics. The implication of this on students' achievement is what this study investigated.

1.1 Statement of Problem

Over the years, students' achievement in physics has prompted educational researchers to continuously make relentless efforts at identifying mitigating factors that might account for the observed poor performance. Some research studies suggest that factors inside and outside the classroom affect students' achievement. Among other variables identified are teacher factors (teacher quality such as teacher's subject matter knowledge, teacher's pedagogical knowledge, teacher-student relationship, teacher's experience, teacher qualification and others). Despite their efforts, students continue to exhibit poor performance in the subject.

In this vein, teacher factor has been linked to be one of the causes of students' poor performance, in this sense there is need to look into the quality of teachers in our secondary schools because effective teaching elicit effective learning. Teacher is the principle initiator of learning. Therefore, this study was designed to survey the teacher quality indicators as correlate of students' achievement in physics.

1.2 Research Questions

This research was guided by two research questions

- 1) What is the joint contribution of teacher quality indicators (pedagogical knowledge, subject matter knowledge, teacher-student relationship, teacher's experience and teacher qualification) to students' achievement in physics?
- 2) What is the relative contribution of teacher quality indicators (pedagogical knowledge, subject matter knowledge, teacher-student

relationship, teacher's experience and teacher qualification) to students' achievement in physics?

2. METHODOLOGY

This study adopted a survey research design of correlational type. Senior secondary two (SS 2) physics students and teachers in Onitsha and Awka Educational Zones of Anambra State, Nigeria were involved. The researchers first visit to the schools was to familiarize and to seek for the consent of the school managements and participants. Schools, teachers and students that were willing to participate were then randomly selected because the number of those that indicated willingness was more than what was needed for the study. The sample was made up of five hundred (500) senior secondary two physics students and fifty (50) physics teachers. Ten (10) physics students and one (1) physics teacher were selected from each of the selected fifty (50) schools.

2.1 Instrumentation

The following instruments were used to collect data in this study;

2.1.1 Students' questionnaire on teacher-student relationship (SQTSR)

It has two sections A and B. Section A contains demographic variables of the students (respondents) and section B contains 18 items that measured teacher- student relationship. To test for reliability, Kuder-Richardson formular 21 was used and the reliability of 0.80 was obtained.

2.1.2 Teachers classroom observation form (TCOF)

This instrument was adapted from [42]. It was used to observe teachers' subject matter knowledge and pedagogical knowledge while they teach in the class. Each teacher was observed two times on separate occasions by the researchers and research assistants. To test for reliability, Cohen-Coppa Analysis was used and an inter-rater reliability index of 0.82 was obtained.

2.1.3 Teachers' demographic characteristics form

This instrument was used to get teachers' year of teaching experience and teacher qualification.

2.1.4 Physics achievement test (PAT)

This instrument was developed by the researchers who were guided by a table of specification. The instrument contains two sections A and B, A contains demographic variables of the respondent such as name of school and class, section B contains physics questions made up of twenty five (25) items drawn from SS1 scheme of work which they are expected to have covered. It included the following topics; measurement and quantities, motion, force, electricity and projectile. Face validity of the instrument was carried out by giving it to two experienced physics teachers who read through and made corrections and after effecting the corrections, copies of the test were made which was administered to students who were not part of the study but similar in characteristics. They were marked and difficulty discriminatory index were calculated, thirty five (35) items were dropped from the initial sixty questions for being either too cheap or too difficult leaving behind twenty five (25) items. To test for reliability, Kuder-Richardson formula 20 was used on the 25-items and the reliability coefficient of 0.77 was obtained. . Based on these, final copies that were used for the study were produced.

2.2 Method of Data Analysis

Data collected were analyzed using t-test and inferential statistics of multiple regressions.

3. RESULTS

The result of the study is presented in the order the research questions were stated:

3.1 Research Question 1

What is the joint contribution of teacher quality indicators (pedagogical knowledge, knowledge of subject matter, teacher-student's relationship and teacher's experience) on students' Achievement in physics?

Table 1 shows that the joint contribution of the independent variables (pedagogical knowledge, knowledge of subject matter, teacher-student's relationship, teacher's experience and teacher qualification) to students' achievement in physics was significant ($F_{(4, 493)} = 5.417, P < 0.05$). When taken together, they jointly correlate positively ($R = .228$) with students' achievement in physics.

This implies that, the five factors have positive multiple relationships with students' achievement in physics. Hence they have the potential of explaining students' achievement in physics to a certain extent. Also the five variables could explain 5.0% of total variance in students' achievement ($R^2 = 0.52$). This leaves the remaining 94.8% to other factors that were not considered in the study and the error (chance).

3.2 Research Question 2

What is the relative contribution of teacher quality indicators (pedagogical knowledge, knowledge of subject matter, teacher-student's relationship, teacher qualification and teacher's experience) on students' achievement in physics?

Table 2 shows the relative contribution of independent variables to students' achievement in physics, it could be inferred from the table that among all the independent variables considered, only teacher knowledge of subject matter had highest and significant contribution to student's achievement in physics ($\beta = 0.227$, $p < 0.05$) while the contribution of pedagogical knowledge ($\beta = 0.016$, $p > 0.05$), Teacher-student relation ($\beta = -.055$, $p > 0.05$), teacher's experience ($\beta = -.017$, $p < 0.05$) and Teacher' qualification ($\beta = .005$, $p < 0.05$) were not significant. This indicates that teacher's knowledge of subject matter plays a vital role in improving student's achievement.

4. DISCUSSION

The findings of this study revealed that combined teacher quality indicators (pedagogical knowledge, subject matter knowledge, teacher-student relationship, teachers' experience and qualification) have significant contributions to students' achievement. A cursory look at this finding shows that teacher quality is very crucial and plays a substantial role in classroom practices. Teacher qualities such as subject matter knowledge, pedagogical knowledge, teacher-student relationship, experience and qualification, when put together correlate positively to students' achievement in Physics. This is in consonance with the study of [28] which shows that combined variables of teacher quality and instructional strategies correlated with students' achievements. Similarly, the research carried out by [43] identified teacher quality as the most important school-related factor influencing student achievement. The findings are also in line with studies of [44]. Similarly, [45] reported that a significant relationship exists between teachers' variables such as gender, area of specialization, possession of academic qualification in education and the learning outcomes of secondary school students.

This result also showed that when taking teacher quality indicators one by one with students' achievement, pedagogical knowledge,

Table 1. Joint contribution of independent variables on student' achievement in physics

Model		Sum of squares	Df	Mean square	F	Sig.
1	Regression	45.767	4	9.153	5.417	.000
	Residual	831.382	493	1.690		
	Total	877.149	497			
R		.228 ^a				
R square		.052				
Adjusted R square		.043				
Std. error of the estimate		1.29992				

Table 2. Relative contributions of independent variables to students' achievement

Model	Unstandardized coefficients		Standardized	T	Sig.
	B	Std. error	Beta		
(Constant)	.095	.743		.128	.898
Pedagogical	.013	.039	.016	.345	.730
Subject-matter	.187	.037	.227	5.111	.000*
Teacher-students relationship	-.042	.036	-.055	-1.171	.242
Teacher experience	-.017	.046	-.017	-.382	.702
Teacher qualification	.008	.073	.005	.109	.914

teacher-student relationship, teachers' experience and qualification no significant contribution to students' achievement in physics except subject matter knowledge. This means that physics teacher's subject matter knowledge is of critical importance to both the teacher and students. Physics teachers that have good understanding of physics will be able to explain physics concepts in simple terms, give familiar examples, link the concepts with students' immediate environment and show how the concepts may be applied to solve problems, all these will bring about meaningful learning of the concepts by the students and good performance in physics. This is in consonant with [24] opinion that there is a positive correlation between teachers' content knowledge and students' achievement. Similarly, [31] submission that teachers who have strong subject matter knowledge give details in their lesson, link the topic to other topics, throw questions to students, stray from the textbooks and promotes students' learning outcome. Similarly, this is in consonance with the assertion of [46] who argued that students taught by more qualified and experienced teachers in terms of knowledge of the subject matter perform better.

5. CONCLUSION

Based on the findings of the study, it is concluded that teacher's subject matter knowledge significantly contribute to students' achievement in physics.

6. RECOMMENDATIONS

- Teachers should be encouraged to cultivate the habit of studying about physics to upgrade their knowledge of the subject.
- Teachers should also be given opportunities for further and continuous studies in physics to improve their content knowledge.
- Teachers should be exposed to seminars and workshops to upgrade and enhance their knowledge of physics.
- Teacher education programme should be given enough attention especially in the area of course content.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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