

## Path Analysis of Teachers' Qualification, Classroom Practices and Students' Achievement in Senior Secondary School Physics

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### Abstract

In this paper, the author examined the relationships between teachers' qualifications and teacher classroom practices and students' achievement in senior secondary school physics. Teachers who read physics and education in the university and demonstrate appropriate classroom practices would encourage students to learn better and do well in physics. Twenty senior secondary school physics teachers and 1064 senior secondary school physics students were randomly selected from twenty senior secondary schools in Ogun and Oyo states, Nigeria. Two instruments were used to collect data: Teacher students Interaction Observation Schedule (Cronbach alpha = 0.61) and Physics Achievement Test (KR-20 = 0.82). Results showed that the model was perfectly fit and there was a significant positive relationship between teacher qualification and classroom practices. It was, therefore, recommended that qualified teachers who had adequate skills to prepare for physics teaching in schools are allowed to teach physics in senior secondary schools.

**Keywords:** Teacher qualification, Lesson development; organisation & presentation, Physics achievement

### Introduction

Physics is the discipline of science concerned with the study of matter and energy, as well as their interactions. Man's reliance on technology demonstrates its value to society. Physics-based technology is the key to any society's technical growth; in other words, Physics is the key that unlocks any nation's technological advancement. Electronics product development, such as cell phones, motorized equipment, and computers, is a test of physics' reliance. Chemistry, geography, oceanography, seismology, and astronomy are just a few of the sciences that rely on physics knowledge. It's a requirement for engineering, medicine, and pharmacy occupations. Among the areas that benefit from physics are chemical biology, agricultural science, medicine, astronomy, and cosmology. In Nigeria's ambition for technological advancement, enrolment and achievement in external examinations conducted by the West African Examinations Council (WAEC) and the National Examinations Council (NECO) fall short of expectations. Students' physics performance in these assessments is a source of concern for the government, educators, and scholars in the field of physics education (Adegoke, 2010).

Students' enrolment and achievement in the subject at previous tests, such as the National Board for Technical Education and Business (NABTEB), begin to drop year after year, according to available literature in Nigeria. Although physics students' performance in WAEC tests (May/June) increased in various years from 2007 to 2014 (51 per cent in 2010, 64 per cent in

2011, 69 per cent in 2012, and 60 per cent in 2014), the progress is insufficient to establish that students have learned physics. Throughout this time, the pass percentage was average, although low performance was seen in 2007, 2008, 2009, and 2013, with 43 %, 48 %, 48 %, and 47 %, respectively.

Ajadi (2017) and Adegoke (2010) outline issues that obstruct students' physics comprehension and achievement. One of the most important issues in the employment of inadequate and inappropriate instructional methods. In situations where a student is underperforming, teachers are frequently blamed. Even in affluent countries, it has been proven that traditional methods of science education cannot deliver the desired results. Traditional approaches have been proven to have negative effects on students' enrolment and performance in physics in research undertaken both within Nigeria (Ajadi, 2017; Adegoke, 2010) and outside Nigeria (Goldhaber & Brewer, 2000). When a teacher supervises class activities, he or she impacts students by offering commands and asking questions that encourage students to participate, as well as sparking students' attention through classroom demonstrations (Kuti, 2006). Physics lessons will pique students' interest, and they will no longer regard the subject as abstract or difficult. As both teacher and students work in engaging and conducive teaching-learning classroom activities, students will have more relevant learning experiences and better time management (Ajadi, 2017). Many strategies that are related to the material being taught are used in teaching.

Teacher characteristics (such as gender, job satisfaction, attitude toward work, teaching experience, qualification, pedagogical content knowledge, teaching skills – lesson preparation, presentation, communication, development, content mastery, classroom organisation, and lesson evaluation) may have a significant impact on students' physics achievement. These variables were the subject of this research.

There is a perfect positive relationship between teachers' qualifications and students' academic progress in chemistry (Mater, Mullens and Moore 2000). Furthermore, there was a significant positive relationship between the qualifications of physics teachers and the accomplishment of students in physics (Ajadi, 2017; Betts, Zau, & Rice, 2003). According to Goldhaber and Brewer, students who had teachers with a bachelor's or master's degree in physics performed better than students who had teachers without a bachelor's or master's degree in physics (2000). In the classroom, tasks such as lesson planning, organization, and content presentation are all part of the teaching and learning process. Many strategies, such as the oral questioning-and-answer method, student-student relationships, and student-teacher relationships, are utilized to increase and maintain students' interest in the lesson. It not only functions as a tool for guiding students through the lesson but also as a means of transitioning from one stage to the next. The teacher must incorporate some of the questions and possible solutions in the lesson note. At the appropriate stage of the lesson's development, provision should be made for the use of relevant instructional resources (McFarland, 2003).

## Figure 1: Path Model of Students' Achievement in Physics

**Key:**  $X_1$  = Teachers' Teaching Qualification;  $X_2$  = Lesson Development;  $X_3$  = Lesson Organisation;  $X_4$  = Lesson Presentation;  $X_5$  = Students' Achievement in Physics.

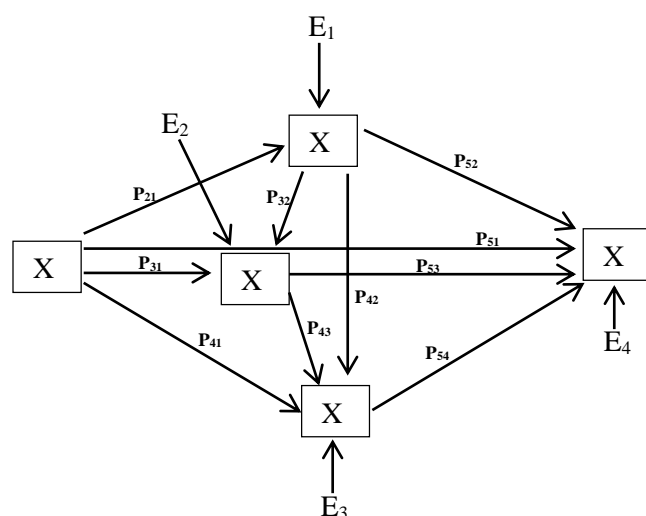
## Research Questions

The study looked for responses to the four research questions below.

1. What is the magnitude and direction of the relationship between teacher qualification, classroom practices, and students' physics achievement?
2. What are the indicators of fit for the hypothesised model for teacher qualification, classroom practices (development, organisation, and presentation), and students' achievement in physics?
3. Is the standardised estimate which describes the causal effects among the teacher qualification, classroom practices (development, organisation, and presentation), and students' achievement in physics consistent with the observed model?
4. What are the estimated variables' direct, indirect, and total effects?

## Method

The study used a correlational research approach to determine the association between the teacher's teaching experience, classroom practices, and students' physics achievement. Twenty schools were picked from Ogun and Oyo states using a simple random sampling procedure, resulting in a total of forty senior secondary schools (SSS2) with a total of 1064 students and twenty Physics teachers participating in the research. The twenty senior secondary school students were between the ages of 16 and 20 years. Sixty-six per cent (66%) of the participants were boys, while 34% were girls. Each sampled school's physics teacher was surveyed. The researcher used and developed two instruments for this study. Teacher Students Interaction Observation Scale (TSIOS) ( $r = 0.61$ ) and Physics Achievement Test (PAT) ( $r = 0.82$ ) are the Teacher-Students Interaction Observation Schedule and Physics Achievement Test, respectively. The TSIOS included two sections: Section A had seven items on name of school, school type, teacher gender, teacher qualification, class observed, time lesson started, and time lesson stopped. Section B



had 20 questions covering three aspects of the teaching-learning process: development, organisation, and presentation. Section B measured teacher qualification as NCE = 1; HND = 2, B.Sc. (Physics + Education) = 3; Master Degree in Physics/Education = 4; PhD (Physics + Education) = 5 and scored as Poor = 1, Fair = 2, Good = 3; Very Good = 4 and Excellent = 5. In seven senior secondary school physics disciplines, PAT was utilised to test learners' intellectual abilities. A total

of 40 items with a four-point response structure were employed. The test items were constructed using a table of specifications based on the first three domains of cognition (knowledge, comprehension, and application). The data were analysed using Pearson Product Moment Correlation with SPSS and AMOS 23 to establish the correlation and test the hypothesised model among the variables.

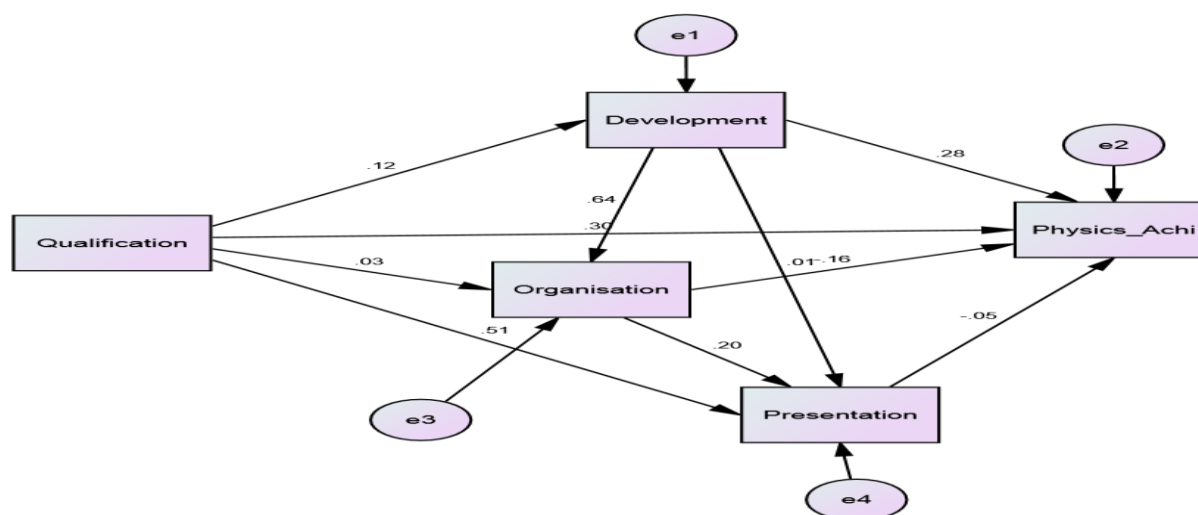


Figure 2: Precursors, mediators, and criteria variables in a structural model

## Results

A matrix of Pearson product-moment correlation coefficients was used to analyse the data, which is shown in Table 1 among the teacher qualifications; the

scores for classroom practices (development, organisation, and presentation) and physics achievement (criterion) were calculated.

Table 1: Descriptive Statistics of the Variables and Correlation Matrix

Variables	N	Mean	Std. Dev.	QLT	DPT	OGS	PST	PSA
Qualification(QLT)	1063	2.65	1.12	1.00				
Development(DPT)	1063	35.88	5.92	0.12*	1.00			
Organisation(OGS)	1063	14.25	3.06	0.03	0.64*	1.00		
Presentation(PST)	1063	13.31	1.72	0.51*	0.01	0.20*	1.00	
Physics Achievement (PSA)	1063	32.50	3.60	0.30*	0.28*	-0.17*	-0.06*	1.00

\* P<.05 is significant

Table 1 demonstrates that, with the exception of teacher competence ( $r = 0.30$ ,  $p < .05$ ) and lesson development ( $r = 0.28$ ,  $p < .05$ ), the link between students' physics achievement and each of the predictors was weak. The connection between teacher qualification, lesson development, and presentation was outstanding. However, the highest relationship among the variables

is lesson organisation and development ( $r = 0.64$ ,  $p < .05$ ), then the path between teacher qualification and lesson presentation ( $r = 0.51$ ,  $p < .05$ ). These relationships explain that teacher qualification is related to teachers' classroom practice.

Path analysis was used to examine the data for this question.

**Table 2: Fit Summary for the 'Just' – identified Model annotated**

Fit Summary	
Chi-Square	.00
Chi-Square DF	0
NFI	1.00
CFI	1.00
GFI	1.00
RMSEA	.33
CMIN	.00
RMR	.00

Since the sample size is so huge, the chi-square test p-value should be considered accurate. Looking at the other fit indices in the table leads to the same conclusion. Several fit indices for the model are obtained in Table 2. The model fit chi-square, for example, is 0, and the degrees of freedom are also 0. This signifies that the model has only recently been established. The Normed Fit Index (NFI) is 1.00, the Comparative Fit Index (CFI) is 1.00, and the Goodness of Fit Index (GFI) = 1.00. Also,  $p = .00$ . All these are perfect fits that reflect a good model fit. However, the root-mean-square error of approximation (RMSEA) is .33 which is too large to be an acceptable model for the data. All of these indices have values that fall within the recommended ranges, indicating overall good model fit (Steiger & Lind, 1980; Browne & Cudeck, 1993, and Hu & Bentler, 1999). Figure 2 shows the structural equation model and standardised estimates of the path coefficients of teacher qualification, development, organisation, and presentation on students' physics achievement.

Data for this question was analysed using path analysis.

**Table 3: Weights for Standardised Regression: (Group number 1 - Default model)**

			Estimate
Development	<---	Qualification	.115
Organisation	<---	Qualification	.026
Organisation	<---	Development	.641
Presentation	<---	Qualification	.513
Presentation	<---	Development	.012
Presentation	<---	Organisation	.196
Physics_Achi	<---	Qualification	.304
Physics_Achi	<---	Organisation	-.165
Physics_Achi	<---	Presentation	-.055
Physics_Achi	<---	Development	.284

The significant pathways for ten paths that illustrate the causal relationship between the variables are shown in Table 3 above (predictor and criterion). Two non-significant causal relationships, qualification – organisation (0.026;  $p < .05$ ) and development – presentation (0.012;  $p < .05$ ), were taken off, leaving only the eight significant paths. Blacklock's updated significant path criterion, as stated in Kerlinger and Pedhazor (1973); Kerlinger (2000); Kline (2005); Adegoke (2009), and Ajadi (2017), required that both the path coefficient and the zero-order correlation be significant at  $p < .05$ .

Path analysis was used to examine the data for this question. Table 4 summarizes the results.

#### Direct Effects

If the model has obtained an overall excellent fit, the second phase of model testing is to analyze the statistical significance of each of the hypothesized direct and indirect effects.

**Table 4: The Path Coefficients of the Physics Achievement Model's Direct, Indirect, and Total Effect**

Paths	Direct Effect ( $\beta$ )	Indirect Effect	Total Effect
<b>To Lesson Development (DPT)</b>			
Teacher Qualification(QLT)	.12*	.00	.12
<b>To Lesson Organisation (OGS)</b>			
Teacher Qualification(QLT)	.03	.07	.10
Development (DPT)	.64*	.00	.64
<b>To Lesson Presentation (PST)</b>			
Teacher Qualification(QLT)	.51*	.02	.53
Development (DPT)	.01	.13	.14
Organisation (OGS)	.20*	.00	.20
<b>To Physics Achievement (PSA)</b>			
Teacher Qualification(QLT)	.30*	-.01	.29
Development (DPT)	.28*	-.11	.17



Organisation (OGS)	-.17*	-.01	-.18
Presentation (PSA)	-.06*	.00	-.06

\* Path coefficient is significant at  $p < .05$

### Indirect Effects

Indirect effects are calculated statistically as the sum of the direct effects that make them up (Kline, 2005). They have also been viewed as path coefficients on their own. For example, the product of the standardised coefficients for the following paths is used to assess the standardised indirect effect of teacher qualification on physics achievement: (QLT to DPT)(DPT to PSA) + (QLT to DPT)(DPT to OGS)(OGS to PST)(PST to PSA) + (QLT to DPT)(DPT to PST)(PST to PSA) + (QLT to OGS)(OGS to PSA) + (QLT to OGS)(OGS to PST)(PST to PSA) + (QLT to PST)(PST to PSA). In terms of numbers, this equals  $(0.12)(0.28) + (0.12)(0.64)(0.20)(-0.06) + (0.12)(0.01)(-0.06) + (0.03)(-0.17) + (0.03)(0.20)(-0.06) + (0.51)(-0.06) = -0.0034536$ . As a result, the indirect effect of teachers' qualifications on students' Physics achievement is roughly 0.00.

**Key:** Qualification (QLT), Development (DPT), Organisation (OGS), Presentation (PST), and Physics Achievement (PSA).

### Discussion

According to the findings of this study, there were significant relationships between teacher's qualification, development, organisation, and presentation. The impact of classroom practices in course preparation, organisation, and presentation on students' physics achievement was also significant. However, teacher qualification was found to be the most relevant element in physics achievement in this study. This shows that the higher the teacher's qualification, the better the students' physics academic accomplishment.

Teachers who have received professional training have been found to have a stronger impact on the students' academic achievement than teachers who have not received professional training. The benefit of professional instructors' educational background is the reason for this clear distinction. This supports the findings of Ajadi (2017), Allen (2010), and Adeyemi (2008), who found that teacher qualification, has a stronger impact on secondary school physics students' achievement. Mayer, Mullens, and Moore's (2000) conclusion that having a well-qualified teacher in every classroom is the most important factor in improving students' achievement was also supported by the findings. Similarly, Goldhaber and Brewer (2000)

noted that qualified teachers play a role in manpower development. The availability of professional teachers is critical to the success of any educational endeavour (Ajadi, 2017). This is achievable because qualified teachers have been taught the technical skills required for effective learning in students. According to the conclusions of this study, the more qualified a teacher is, the more relevant learning experiences he or she may provide for students, which could improve accomplishment in school subjects, particularly in physics.

### Conclusion

The outcomes of this study suggest that highly skilled teachers who apply suitable classroom practices (lesson planning, lesson organisation, and lesson presentation) have a positive impact on the academic growth of secondary school students.

### Recommendations

Based on the study's findings, the following recommendations were made:

- All secondary school physics teachers should have quality classroom practices to improve student's academic achievement.
- The government should employ and encourage more experienced teachers to teach senior secondary school physics and worthwhile science allowances.

### References

- Adegoke, B. A. (2009). Teacher influence as a determinant of dependent-prone students' learning outcomes in geometry in Ibadan Southeast, Nigeria, Unpublished Ph. D. Thesis. Institute of Education, University of Ibadan, Ibadan.
- Adegoke, B. A. (2010). Integrating animations, narrations and textual materials for improving students' learning outcomes in senior secondary school Physics. *Electronic Journal of Research in Educational Psychology* 8, 725-731.
- Adeyemi, T. O. (2008). Teachers' teaching experience and student learning outcomes in secondary schools in Ondo State, Nigeria. *Educational Research and Review*, 3(6), 204-212.



- Ajadi, T. A. (2017). Structural equation modelling of teachers' characteristics, classroom behaviour and students' achievement in the Southwest, Nigeria. (Unpublished doctoral thesis) Department of Science and Technology Education, University of Ibadan, Nigeria
- Allen, K. P. (2010). Classroom management, bullying and teacher practices. *The Professional Educator* 34.1: 1-15.
- Betts, J. R.; Zau, A. C., & Rice, L. A. (2003). New insights into school and classroom factors affecting student science achievement. Retrieved from the Web January 8, 2004. <http://www.ppic.org>
- Browne, M. W. & Cudeck, R. (1993). 'Alternative ways of assessing model fit,' in K. A. Bollen and S. Long, eds., *Testing Structural Equation Models*. Newbury Park, CA: Sage Publications.
- Goldhaber, D. D. & Brewer, D. J. (2000). Does teacher certificate matter? High school teacher certification status and student achievement. *Education Evaluation and Policy Analysis* 22, 129-145.
- Hu, L. & Bentler, P. (1999). Cut off criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural equation modelling* 6.1-55.
- Kerlinger, F. N. & Pedlhzur, E. (1973). *Multiple regression analysis in behavioural research*. New York: Holt, Rinehart and Winson.
- Kerlinger, F. N. (2000). *Foundations of Behavioural Research*. Harcourt College Publishers.
- Kline, R. B. (2005). *Principles and practice of structural equation modelling (2<sup>nd</sup> ed.)* New York: The Guildford Press.
- McFarland, H. S. N. (2003). *Intelligent Teaching*, London: Routledge and Kegan Paul.
- Mayer, D. P., Mullens, J. E. & Moore, M. T. (2000). Monitoring school quality: An indicators report, National Center for Education statistics. Retrieved May 10, 2015 from <http://www.nces.org>
- Steiger, J. H. & Lind, J. C. (1980). 'Statistically based tests for the number of common factors' Paper presented at the annual meeting of the Psychometric Society, Iowa City, IA.