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Teachers' Professional Development as a Correlate to Students' Academic Achievement in Mathematics

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Abstract

This study examined how teachers' professional development correlates to students' academic achievement in Mathematics. Correlation research design was used for the study. Two research questions and two null hypotheses guided the study. The population of the study comprised of all the public senior secondary two (SSII) students and forty (SSII) Mathematics teachers of Nsukka Local Government Area. Simple random sampling techniques was used to select 150 senior secondary two (SSII) and 30 (SSII) mathematics teachers from 20 secondary schools for the study. The instruments used for data collection for this study was Teachers' Professional Development Questionnaire (TPDQ and Students' Terminal Results (STR). The internal consistency reliability indices of TPDQ was 0.90 was obtained using Cronbach Alpha. Regression analysis was used to answer the research questions. Hypotheses was tested STR using ANOVA (regression output) and the associated p-value for interaction obtained from moderation analysis all at 0.05 level of significance. The result of this study revealed that there is a significant weak relationship between teachers' professional development and Students' academic achievement. It was recommended among others that the government should arrange workshops, seminars, conferences for teachers to attend and improve their knowledge.

Keywords: Teachers' Professional Development, Students' Academic Achievement, Mathematics.

Introduction

Mathematics and human life are related to each other like a relation between muscles and bone of human body. In this modern age nobody can live without the knowledge of Mathematics. It is intimately involved in every moment of every one's life. Teacher helps students to gain Mathematical knowledge. Teachers' professional development is needed for teachers to transfer mathematical knowledge to students for better academic achievement in mathematics. According to Stein (2021), Mathematics is the science of numbers and shapes, including arithmetic, geometry, algebra, and calculus, that deals with the study of quantities, magnitudes, and shapes, as well as their relationships and operations. Mathematics is a vast and dynamic field that explores numbers, quantities, shapes, and patterns, as well as their intricate relationships and operations, spanning subfields like algebra, geometry, calculus, and statistics, and serving as a fundamental tool for problem-solving and critical thinking in diverse disciplines, including physical and natural sciences, engineering, economics, finance, and data analysis

(Krantz, 2020). Mathematics is a fundamental driver of technological innovation and economic growth, serving as a crucial tool for problem-solving, critical thinking, and data analysis, and its applications are essential for transforming scientific discoveries and technological advancements into practical realities (Organisation for Economic Co-operation and Development & National Council of Teachers of Mathematics, 2018, 2020). Mathematics is the foundational language of science, providing the theoretical framework and analytical tools necessary for understanding and advancing scientific knowledge and its applications are essential for legitimizing and validating scientific discoveries and technological innovations (Baker, 2019).

The importance of Mathematics has also been viewed by various researchers. Mathematics is an essential tool for problem-solving and critical thinking Stein (2021). By solving mathematical problems, individuals can improve their logical skills and analytical thinking. Mathematics is also crucial in finance, as it helps individuals manage their money effectively and make informed decisions about investments and expenses (Kiewiet, 2019). Even in everyday activities like cooking, mathematics is necessary for accurate measurements and proportions (Hill, 2020). Moreover, mathematics offers great career opportunities for students, as every career uses mathematics in some way (Bureau of Labor Statistics, 2021). Furthermore, mathematical knowledge plays an essential role in understanding concepts in other subjects like science, social studies, and even music and art (Kilpatrick & Swafford, 2019). Mathematics gives individuals an effective way to create mental discipline and increase logical reasoning (Boaler, 2016)

Despite the importance of mathematics, there are academic achievement irregularities noticed by teachers, parents, school authorities on students' continuous assessment, internal and external examinations. Evidence of such can be seen from mass failure of students in external examinations in most secondary schools. And this has been a thing of great concern to mathematics educators, parents and government. The poor achievement of students in mathematics may be influence by the teachers' perception of the efficacy and quality of their training and development programs. Mathematical knowledge can only be achieved through teaching and learning and assessed through Students' achievement in mathematics.

Academic achievement is the extent to which a student, teacher or school has attained their short or long-term educational goals. A student's academic achievement is usually measured by teacher-made tests or standardized tests which in most cases are referred to as external examinations like the Basic Education Certificate Examination (BECE), Senior School Certificate Examination (SSCE) conducted in Nigeria by the West African Examination Council (WAEC) and the National Examination Council (NECO) (Kpolovie, Ololube & Ekwebelem, 2015). However, the academic achievement of students in Mathematics may result from environmental factors such as student characteristics, home related factors and school environmental factors. In the same vein, Kpolovie, Joe and Okoto (2014) noted that there are three major distinct groups of factors that have been found by psychologists to influence academic achievement in mathematics, such as; student characteristics, home environment and school context. However, in line with the above, Agwuma, Ochogba & Agwuma (2018) noted that academic achievement in mathematics depends on the amount of time a child is actively engaged in learning because, the time spent on studying helps students to retain the materials learnt which may also boost the student's academic achievement in mathematics during test or examination. The author also opined that when teacher is able to initiate creative activities in the school it enhances students learning ability and also influences their academic achievement in mathematics examination. A number of studies have been carried out to identify the factors that affect Students' academic achievement in mathematics in a number of

educational institutions worldwide. Most of these studies focus on three elements, that is, parents (family causal factors), teachers (academic causal factors) and students (personal causal factors) (Crosnoe, Johnson & Elder, 2014). The study of Stein (2021) attributed poor achievement of students in Mathematics to poor teaching methods and curriculum design. Koenig (2019) also revealed that poor achievement of students in Mathematics is as result of lack of qualified and effective Mathematics teachers. From the above, this calls for a professional development of teachers to avert this challenge.

Teachers' Professional development is a formal in-service training to upgrade the content knowledge and pedagogical skills of teachers. It is widely viewed as an important means of improving teaching and learning standards (Meichen, 2017). For a teacher to be called a professional teacher he must have a qualification in Education and this qualification can only be obtained through a period of intense training and subsequent in-service training. A trained and skillful teacher has more ability to teach the students and implement the various teaching methods successfully for the better academic achievements of students (Saira & Bolt, 2021). When teachers apply the various teaching methods and techniques according to the acquired skills then student's academic achievement would be high and their interest in learning increased (Wuryaningsih, Plez & Nunez, 2019). In other words, to improve the quality of students and graduates of any school or educational system is predicated on the total quality of its teacher (Awodiji & Ijaiya, 2019). It was stated that all forms of development begin with capacity building; quality education can only be attained if there is investment in human capital development (Awodiji, 2018). The acquisition of skills, knowledge, right attitude and its productive utilization are germane to actualization of quality education. Seaze (2023) indicate that, there is a significant positive relationship between students' academic achievement in mathematics and teachers' qualification, experience and background. Teacher with good qualifications in mathematics have their students performing better in mathematics.

Studies have shown that qualification of the teachers play important role in student's academic achievement. According to Zuzovsky (2019), the most important factors in the teaching process is a qualification of the teacher. A qualified teacher has a good classroom control, effective communication skills, and adequate knowledge of the subject matter and can utilize varieties of teaching strategies in order to enhance students' academic achievement mathematics. The perspective of was that teachers' qualifications can go a long way to bring about students' higher academic achievement. Teachers' profession relates to competence in instruction and management of students and materials in the classroom. Teachers' qualifications, therefore, might not only be the certificate someone is holding as erroneously conceived by some people. Teachers' qualifications are more than just holding a certificate of any institution. Teacher qualification may affect students' academic achievement. This study investigates the relationship between teachers' professional development and students' academic achievement in mathematics. The problem of this study therefore is; "what is the relationship between perceived teacher professional development and student's academic achievement in mathematics."

Research Questions

The study was guided by the following research questions:

1. What is the relationship between teachers' professional development and students' academic achievement in mathematics?
2. What is the relationship between teachers' professional development and students' academic achievement as moderated by qualification?

Hypotheses

The following hypotheses were formulated to guide the study.

Ho_1: There is no significant relationship between teachers' professional development and students' academic achievement in Mathematics

Ho_2: There is no significant relationship between teachers' professional development and students' academic achievement based on qualification.

Research Method

The study was conducted using a correlation survey research design. This study was carried out using SS II students and SSII Mathematics teachers in Nsukka Local Government Area of Enugu state, Nigeria. Nsukka Local Government Area is one of seventeen (17) Local Government Area of Enugu state. It shares boundaries with Igbo-Etiti L.G.A on the South, Uzor-Uwani L.G.A on the West, Udenu L.G.A on the East, and Igboeze-North L.G.A on the North, all in Enugu state. The population of the study comprised all the public senior secondary two (SSII) students and forty (SSII) Mathematics teachers of Nsukka Local Government Area. Simple random sampling techniques was used to select 150 senior secondary two (SSII) students and 30 (SSII) mathematics teachers from 20 secondary schools for the study. The sample size was determined using Taro Yamane formula. Purposive sampling technique was used to select 20 schools with the highest number of SSII students. Also 30 (SSII) mathematics teachers were selected from the sampled schools.

Instrument

The instruments use for data collection for this study was Teachers' Professional Development Questionnaires (TPDQ) and Students' Terminal Results (STR). Teachers' professional Development Questionnaire (TPDQ) is a researcher-developed instrument consisting of ten (10) items. The instrument was designed to elicit the following information: teacher qualifications, gender, and exposure (workshops, seminars, mathematics competition). The TPDQ has the following response options: Very often (VO); Often (O); Seldom (S) and Never (N). Very Often carries 4 points, Often carries 3 points, Seldom carries 2 points and Never carries 1 point.

These instruments were face validated by three experts from University of Nigeria Nsukka, two from Mathematics unit, and one from Measurements and Evaluation, all from Department of Science Education. The experts validated the instruments with respect to the clarity of the items statement and whether the items are in line with the purpose of the study. To ascertain the reliability of the TPDQ, the instrument was trial tested using twenty (20) SS II students and four (4) SS II mathematics teachers in community secondary School Ede- Oballa. A reliability index of 0.90 was obtained using Cronbach Alpha. This method was adopted because the instrument is polytomously scored. To collect data for the study for the study, the instruments were administered to the respondents and collected immediately by the researcher. Regression analysis was used to answer the research questions, while the hypotheses were tested using ANOVA (in the regression output) and the associated p-value for interaction obtained from moderation analysis all at 0.05 level of significance. To interpret the result, value of r ranging from 0.0 – 0.30 indicated weak relationship, 0.31 – 0.60 indicated moderate relationship, 0.61 – 1.0 indicated strong relationship (Fraaenvekel, Wallen & Hyun, 2012). Positive R-values indicated a positive relation among the variables while negative R-values indicated negative relationship among the variables.

Results

The results for this study were organized in tables according to the research questions and corresponding hypotheses.

Table 1: Linear Regression Analysis of the relationship between teachers' professional development and students' academic achievement in mathematics.

Model	N	R	R Square	Adjusted R Square	Standard Error
1	30	0.034	0.001	-0.035	8.797

Table 1 presents results for the analysis of data collected to determine the relationship between teachers' professional development and students' academic achievement in mathematics. The results indicates that the correlation coefficient (r) of 0.034 was obtained for the relationship between teachers' professional development and students' academic achievement in mathematics. This indicates that there is a weak relationship between teachers' professional development and students' academic achievement in mathematics. A coefficient of determination (r^2) of 0.001was also obtained and this indicates that 0.1% of variation in students' academic achievement in mathematics can be attributed to teachers' professional development.

Table 2: Regression ANOVA of the relationship between teachers' professional development and students' academic achievement in mathematics.

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	2.516	1	2.516	.033	.858
	Residual	2166.850	28	77.388		
	Total	2169.367	29			

Table 2 presents result from the analysis of data collected to determine whether or not the relationship between teachers' professional development and students' academic achievement in mathematics was significant. The regression ANOVA shows that an F-ratio of 0.033, with an associated p-value of 0.858 was obtained. Because the probability value of 0.858 is greater than 0.05 level of significance, the null hypothesis is not rejected. This is an indication that there is no significant relationship between teachers' professional development and students' academic achievement in mathematics.

Table 3: Process Moderation Analysis of the influence of qualification on the relationship between teachers' professional development and students' academic achievement.

Gender	N	R	R-sq	MSE	F	df1	df2	P
NCE	3	0.314	0.098	75.237	0.945	3.00	26.00	0.433
B.Ed	3							
BSc.Ed	10							
M.ED	11							
Ph.D	3							

Result on table 4 shows the process analysis output of regression on the moderating influence of qualification on the relationship between teachers' professional development and

students' academic achievement. From the result, a correlation coefficient (r) of 0.314was obtained. This is an indication that qualification moderately influences the relationship between teachers' professional development and students' academic achievement. The coefficient of determination (r^2) of 0.098 indicates that only 9.8% of students' academic achievement in mathematics attributed to teacher's professional development is influenced by qualification.

The process analysis result on table 4 shows that an F-ratio of 0.945 with an associated probability value of 0.433was obtained for the moderating influence of qualification on the relationship between teachers' professional development and students' academic achievement. The result shows that the p-value is greater than 0.05 level of significance. Hence, the null hypothesis is not rejected. This is implies that relationship between teachers' professional development and students' academic achievement as moderated by qualification is not significant.

Discussion of Findings

This study indicates a significant weak relationship between teachers' professional development and students' academic achievement in mathematics. This implies that teachers' professional development has impact on Students' academic achievement in mathematics. This study is in-line with the findings of Thuo (2019) who also found out that there is a relationship between teachers' professional development and students' academic performance. The results of the study show that even though the quality of teachers was high in terms of their academic and professional qualifications, it did not reflect much in the performance of the students. The result of this study disagrees with Osei-Owusu (2022) which showed that professional development of teachers has a significant positive relationship with Students' academic performance. The weak significant relationship between teachers' professional development and students' academic achievement in mathematics indicated that there are other factors that can contribute more to students' academic achievement than teachers' professional development.

In this study, it was discovered that a significant moderate relationship exists between teachers' professional development and students' academic achievement as moderated by qualification. This study is consistent with that of Muyombana, Letanzio & Mukamazimpaka (2021), which revealed that teacher qualification can have an impact of 36.5% on students' academic performance and the remaining 63.5%could be affected by other variables. On the other hand, the result of this study is in disagreement with that of Itanka (2023) which was based on the relationship between teachers' qualification and the impact on Student`s academic achievements in Senior Secondary School Mathematics in Taraba state. The findings of this study revealed that there is significant strong positive relationship between instructional material usage and Students Achievement in senior secondary school Mathematics. The result of this study showed that there is a moderate relationship between teachers' professional development and students' academic achievement. This result could have been like this because there are other factors that can contribute more to students' academic achievement than teachers' academic qualification.

Conclusions

Based on the findings of this study, the following conclusions are drawn:

There was a significant weak relationship between teachers' professional development and students' academic achievement. There was a significant moderate relationship between teachers' professional development and students' academic achievement as moderated by qualification.

Recommendations

1. The government should arrange workshops, seminars, conferences e.t.c for teachers to attend and improve their knowledge.

2. The school authority should ensure that both male and female teacher are employed leaving no room for discrimination or favouritism because, male teachers is as effective as the female teacher.
3. The school authority should ensure that the teaching staff also contains teachers with higher qualification, those teachers could be more professionally sound as a result of their qualification gained overtime.
4. The school authority should ensure in-service training program for teachers are arranged for teachers to improve the teaching ability.

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