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Effects of Teachers' Qualifications on Performance in Further Mathematics among Secondary School Students

[1]Umar Abubakar Aliyu [2]Ahmad Yashe [3*]Awogbemi Clement Adeyeye
[1,2] Department of Mathematics & Statistics,Nuhu Bamalli Polytechnic Zaria,
Kaduna State, Nigeria.
E-mail: umar.aliyu2@gmail.com, muayashe@gmail.com
[3] National Mathematical Centre, P.M.B 118, Garki, Abuja, Nigeria
*E-mail of the corresponding author: awogbemiadeyeye@yahoo.com

Abstract
This study examined the effects of teachers' qualifications on performance in further mathematics among secondary school students in Kaduna state. By purposive sampling, 12 senior secondary schools were selected from four inspectorate divisions in the state namely Anchau, Kaduna, Kafanchan and Zaria which participated in this study. In the second stage, a random sample of 160 further mathematics students were finally selected across the four divisions. Two instruments: Teacher Self Assessment Test (TSAT) with reliability index of 0.87 and a 30-item four option multiple choice Further Mathematics Achievement Test (FMAT) constructed by the researchers (with cronbach's alpha of 0.87 and item difficulty of $0.40 < p < 0.82$) were administered. Two research questions and one hypothesis were formulated to guide the study. The Analysis of Variance (ANOVA) revealed that significant difference exists between students performance on account of their teachers' qualifications.
Keywords: Performance, Teachers' - Qualification, Teacher Self Assessment Test, ANOVA, Reliability Index

1. Introduction

Education at secondary school level should supposedly be the bedrock and sure foundation for higher knowledge in tertiary institutions. It is an investment as well as an instrument that can be used to achieve a more rapid economic, social, political, technological, scientific and cultural development in the country. The Federal Ministry of Education (2007) by emphasizing the National Policy stipulated that secondary education is an instrument for national development that fosters the worth and development of the individual for further education, general development of the society and equality of educational opportunities to all Nigerian children, irrespective of any real or marginal disabilities. The role of secondary education is to lay the foundation for further education and if a good foundation is laid at this level, there are likely to be fewer problems at subsequent levels.

The Wikipedia (2010) describes Further Mathematics as the title given to a number of advanced secondary mathematics courses. In Nigeria, Further Mathematics happens to be one of the subjects designed to be studied at secondary school level. As stated in the National Curriculum for secondary schools volume 5 of the Federal Ministry of Education (1988), the aims and objectives of Further Mathematics are to: help develop further conceptual and manipulative skills and their applications; provide an additional intermediate course of study which bridges the gap between elementary mathematics and higher mathematics and meet the needs of potential mathematicians, Engineers, Scientists and other professionals, such as Businessmen and Administrators and Architects.

National Council for Curriculum Assessment (2005) noted that many students view mathematics as a difficult subject and perceive higher mathematics as an elite subject for only the best students. Though the subject was made non compulsory for students, which explains their fewness, the performance of these students is not encouraging after all. One may be right to think that students' performance in Further Mathematics should be high since it is the students that make a choice to offer the course. But unfortunately the results of previous studies on students' performance in Further Mathematics have been full of apathy showing the sorry state of affairs surrounding Further Mathematics in the country (Balogun, 1986). Poor academic performance according to Aremu & Sokan (2003) is one that is adjudged by the examinee/testee as falling below an expected standard. Poor academic performance has been observed in school subjects especially mathematics among secondary school students (Adesemowo, 2005). Over the past decades, educational planners, policy makers and administrators all over the world have become increasingly concerned about the quality of education provided by the school system. They have come to realize that many meaningful improvements in the quality of education that students receive are highly dependent on the quality of teachers (Anderson, 1991).

Studies carried out had indicated the need for teachers' academic qualification in their various teaching subjects. In an investigation, Etim (1985) found that teachers gained enough skills from a preparatory programme to enable them teach their subjects at any level of secondary school. This points to the need for appropriate training in the subject matter area of teachers so that their classroom instruction could be above board. Otuka (1987) found out misconceptions in students which they traced to misconceptions held by their teachers. Research also shows that teacher knowledge of specific subject matter, particularly at the secondary level is a good predictor of student achievement. Monk (1994) finds a strong correlation between teacher subject matter preparation in mathematics and student success for both low and high scoring students, while Goldhaber & Brewer (2002) noted that students do better in mathematics if taught by a teacher with a bachelor's or master's degree in mathematics. The professional needs of a teacher vary in relation to the stage he/she is in the profession. Teachers have different professional needs; hence the supports of an inexperienced teacher needs differ from that of a professional teacher. Supervision and coaching are critical elements of professional growth and development (Rockoff, 2004). The importance of in-service training programme in improving teachers' classroom interaction pattern cannot be over emphasised. The effectiveness of the Associate Certification in Education (ACE Sandwich) training programmes of the Institute of Education, University of Benin was acknowledged by Igwebuike (1985). Students however stand the danger of being misinformed or misled by a teacher with little knowledge about subject matter. It is important to note also that too much specialized theoretical knowledge could lead teachers to make course content unnecessarily theoretical and impractical. There is the need for training of Further Mathematics teacher, as it was found out that some teachers of Further Mathematics deliberately skip certain topics in the syllabus hence losing confidence of their students due to their inability to deliver the "stuff" properly. As stated by Anyip (1989), Jahun & Korau(1991), the assertion that teachers perception of their competence to teach Further Mathematics differs significantly according to their qualifications.

1.1 Objectives of the Study

The study aims at the strategic identification of effects of Teachers' qualifications on performance of students offering Further Mathematics in Kaduna state secondary schools. To achieve these, the researchers focused extensively to;

1. identify the level of competency required by teachers to influence positively on students' performance in Further Mathematics.
2. identify and proffer possible suggestions that can improve the level of students' performance in Further Mathematics across the schools in the state.

1.2 Research Questions

This study attempted to answer the following research questions.

1. What is the effect of Teacher qualifications on students' academic performance in Further Mathematics?
2. What significant difference exists between performances of students taught by teachers with different academic qualifications?

1.3 Null Hypothesis

On the basis of the research questions, the following null hypothesis was formulated and tested.

HO1: There is no significant difference between teachers' qualifications and academic performance of students of Further Mathematics.

1.4 Significance of the Study

It is envisaged that a careful identification of the teachers'-qualifications will provide the state education board with possible means of improving student's performance in the subject as it concentrates on the issues of teacher quality. The study will also help Further Mathematics teachers to see the need to improve their knowledge on the subject; by way of seminar and workshops or additional academic qualification so as to appropriately have more positive impact on their students. As stated by Ale (1989) no nation rises above the level of her teachers. This brings to bear the necessity to improve, in fact constantly improve the academic capabilities of the teacher as this will in turn have impact on the social and scientific base of the nation. This study has provided the teacher and educational policy makers with information on the need for retraining so as to keep the teacher abreast with the latest and best practices in their area of specialization to give out the best in the dissemination of knowledge to the students.

1.5 Population of the Study

The study population comprised students and teachers of Further Mathematics in all senior secondary schools in Kaduna state. There are presently 234 secondary schools divided into 12 inspectorate divisions for ease of administration in Kaduna state. These inspectorate divisions are not based on Local Government basis.

The target population for the study specifically comprises all senior secondary school SSI–SSIII students and their teachers in four inspectorate divisions of Kaduna State namely, Anchau, Kaduna, Kafanchan and Zaria (a

total of 12,512 students). Kaduna State is divided into twelve inspectorate divisions with a population of 14,277 SSIII students.

Of the one thousand nine hundred and sixty five (1,965) science subject teachers in the state, five hundred and forty seven (547) teach Mathematics. Within this is where those teaching Further Mathematics can be found as there are no specific records on those specifically teaching Further Mathematics. Reason for this may not be far fetched, as Further Mathematics (FM) teachers are not recruited separately; but as Mathematics teachers.

The selection of the four divisions was based on the information gathered from records of Educational Resource Centre Kaduna on the divisions that present candidates for Further Mathematics at SSCE frequently. Three senior secondary schools from each of the four divisions with a composite of at least one private owned and two government owned secondary school participated in this study. A purposive sampling technique was employed for selecting the Samples size in this study, because most students offering Further Mathematics (FM) are found greatly in some divisions than others. Furthermore, the school must have registered and presented candidates for SSCE. Therefore, in order to reduce wild chase of non-existing sample population, the study identified the divisions where Further Mathematics is being offered up to SSCE levels in Kaduna state and these were concentrated upon for the generalization of the findings of this study. A simple random sampling technique was used to select 160 Further Mathematics students across the four divisions.

2. Methodology

The study adopted the survey research design as the researchers were only interested in determining the influence of the independent variables (Teacher's Qualification) on the dependent variable (Further Mathematics achievement of students) without any manipulation of variables. Data were collected through the administration of a Teacher Self Assessment Test (Questionnaire) and structured interview was conducted on the available members of staff at the selected schools to further buttress the data collected from teacher's questionnaires.

2.1 Instrumentation

The research instruments adopted for collection of primary data are Teachers Self Assessment Test (TSAT) Questionnaire and Further Mathematics Achievement Test (FMAT) developed by the researchers. TSAT aimed at eliciting information on teachers as regards their academic qualifications, techniques of teaching and assessments they often use to get feedbacks from students. The TSAT reliability coefficient was established through cronbach's alpha and the reliability index yielded 0.87. It consists of 25 items divided into two sections: Section A consists of five items of personal information, section B deals with teacher factors such as; methods of teaching, methods of assessment, participation in in-service training programs, job satisfaction and ways of improving the deficiencies observed. The Questionnaire follows a 5 point-Likert scale (i.e., Strongly Agree, Agree, Undecided, Disagree, Strongly Disagree) structure.

The Further Mathematics Achievement Test (FMAT) was also developed by the researchers to assess the level of acquisition of Further Mathematics concepts of SSIII students. It is a forty-five minute, thirty (30) item multiple choice test covering the main topics of the Further Mathematics curriculum such as pure mathematics, mechanics and statistics. FMAT has test-retest reliability of 0.77 and item difficulty of $0.40 < p < 0.82$). The items were set based on the table of specifications in Table 1

Table 1: Specification for Further Mathematics Achievement Test (FMAT)

Content	**Knowledge (30%)**	**Comprehension (20%)**	**Application (20%)**	**Thinking (30%)**	**Total**
Pure Mathematics (50%) **Mechanics (20%)** **Statistics (30%)**	**4** **3** **3**	**2** **2** **2**	**2** **2** **2**	**3** **2** **3**	**11** **9** **10**
Total	**10**	**6**	**6**	**8**	**30**

2.2 Results

Hypothesis 1:

There is no significant difference between teacher qualifications and academic performance of students of Further Mathematics.The following tables reveal the relationship between student's performance and teacher's qualifications.

Table 2(a): Descriptive statistics showing students performance in Further Mathematics on account of their teacher's qualification.

Teachers Qualification	N	Mean Performance of students	Standard Derivation	Std. Error
NCE	9	7.6667	1.50000	0.50000
HND	25	6.0800	2.36150	0.47230
B.Sc	14	9.8571*	3.71809	0.99370
B.Sc (Ed)	41	8.8293	4.28895	0.66982
B. Sc (Ed)	71	8.1549	3.16069	0.37510
Total	**160**			

The above table shows that teacher academic qualification influence student's academic performance in Further Mathematics. The table revealed the students Mean performance in Further Mathematics as 6.0800, 7.6667, 8.1549, 8.8293 and 9.8571 for students taught by teachers with academic qualifications of HND, NCE, MSc (Ed), B.Sc (Ed) and B.Sc respectively.

The Analysis of Variance (ANOVA) was used to verify whether there were differences on students' performance on account of their teachers' qualification as presented in Table 2(b) below.

Table 2(b): Summary of Analysis of Variance (ANOVA) Statistics on the difference in students' performance on account of teacher qualification.

Variations	Sum of Squares	df	Mean Square	F Ratio	F Critical	P value
Between Groups	168.845	4	42.211	3.703	2.60	0.007
Within Groups	1766.655	155	11.398			
TOTAL	1935.500	159				

The Analysis of Variance (ANOVA) in table 2(b) revealed that significant difference exists between students performance on account of their teachers qualification, since $3.703 > 2.60$, and $0.007 < 0.05$ level of significance set.

To further establish where the significant differences lie between groups of teachers' qualifications, a post hoc (LSD) test was performed as presented in Table 2(c) below

Table 2(c) Post Hoc (LSD) Multiple Comparison test on the differences between students performance according to teachers' qualification.

Teachers Qualification(I)	Teachers Qualification (J)	Mean Difference (I – J)	Standard Error	P value
NCE	HND	1. 58667	1.31238	.229
	B.Sc	2. 19048	1.44241	.131
	B.Sc (Ed)	1.16260	1.24274	.351
	M Sc	–.48826	1.19455	.683
HND	NCE	–1.58667	1.31228	.229
	B.Sc	–3.7714*	1.12696	.001
	B.Sc (Ed)	–2.74927*	.85668	.002
	M Sc	–2.07443*	78514	.009
B.Sc	NCE	2.19048*	1.44241	.131
	HND	3.77714*	1.12696	.001
	B.Sc (Ed)	1.02787	1.04505	.327
	M Sc	1.70221	.98725	.087
B.Sc (Ed)	NCE	1.16260	1.24274	.351
	HND	2.74927*	.85668	.002
	B.Sc	–1.02787	1.040505	.327
	M Sc	.67434	.66221	.310
M Sc	NCE	.48826	1.19455	.683
	HND	2.07493*	.78514	.009
	B.Sc	–1.70221	.98725	.087
	B. Sc (Ed)		.66221	.310

* The mean difference is significant at the .05 level.

The Post HOC Multiple Comparison (LSD) test in table 2(c) further revealed that significant difference exists between students taught by HND teachers and those taught by either B.Sc, B.Sc(Ed) or M.sc teachers as the HND taught students had the least performance. It showed that the HND and NCE taught students had the least performance compared with B.Sc, B.Sc (Ed) and M.sc taught students.

Therefore, the null hypothesis which states that there is no significant difference among students performance on account of their teachers qualification, is hereby rejected, thus accepting the assertion that there exists a significant effect with teachers' qualifications and students' academic performance in Further Mathematics.

3. Discussion of Results

The Analysis of Variance (ANOVA) in table 2(b) confirmed past findings as reviewed, which indicated positive effect between teacher educational qualifications and student's achievement. The implications of this result seem to support the view such as Vogt (2001) and Ehrenberg & Brewer (1994) which suggest that measures of teacher academic qualifications represent one of the best predictors of students' better performance. Furthermore table 2(c) using Post Hoc (LSD) Multiple Comparison test revealed that significant difference exists between students taught by HND teachers and those taught by either B.sc, B.sc(Ed) or M.sc teachers as the HND taught students had the least performance. It showed that the HND and NCE teachers taught students had the least performance compared with B.sc, B.sc (Ed) and M.sc teachers taught students. This result also agrees with Goldhaber & Brewer(2002) finding, which noted that students do better in Mathematics if taught by a teacher with bachelor's or master's degree in mathematics and contradicts the finding of Goldhaber & Brewer (1997) which found that a teacher's advanced degree is not generally associated with increased students' achievement. This result too sends a message to the degree of teacher preparation in our Colleges of Education and HND awarding institutions. It also draws attention to the need to review such existing syllabuses.

4. Conclusion:

The findings of this study in conjunction with a number of other studies in recent years reveal some noteworthy results. The identified independent variable affects the performance of students in FM; the level of educational attainment of teachers' qualifications is positively related with students' outcome. The results of this study, though relatively small in scope, suggest a number of implications for policy intervention to improve the quality of teachers which will consequently improve students' achievement.

5. Recommendations:

Based on the findings of this study, the researchers made the following recommendations.

1. A recommended number of years could be specified for teachers as mandatory to acquire additional academic qualifications in their area of specialization (Mathematics).
2. All students (especially science students) should be encouraged to offer Further Mathematics as this will enhance their performance in mathematics and other science subjects.
3. Teachers of Further Mathematics should explore the right strategies to teach the subject so that students will understand and apply the knowledge in other subject areas.
4. Every senior Secondary School should endeavour to offer Further Mathematics in order to have enough prospective qualified science and engineering students in the institution of higher learning.
5. The National Universities Commission (NUC) should make a pass in Further Mathematics prerequisite for admission into some of the programmes as part of the uniform minimum standard expected of universities.
6. The Federal government should also classify Further Mathematics as a core subject for science, engineering and students of architecture.
7. For a developing country like Nigeria to make any meaningful progress as regards the academic performance of students, concerted, deliberate and dedicated efforts must be made towards the development of the psychological, mental and conceptual capabilities of the teachers

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