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Professionalism in Teaching Mathematics: Demographic Profiling of Secondary School Mathematics Teachers

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Abstract
The purpose of this study was to chart a demographic profile of secondary school mathematics teachers using the key variables of length of teaching experience, subject of study in the university, and highest academic qualification. The study was guided by one research question and two hypotheses. The study was conducted in Taraba State, Nigeria. The target population was all secondary school mathematics teachers in the state. The sample was 327 secondary school mathematics teachers. They were drawn from 60 secondary schools, through a multistage sampling procedure that consisted of stratified, simple random, and purposive sampling techniques. The instrument for data collection was Problem Solving Self Administered Questionnaire (PSSAQ). The result showed that teachers who teach mathematics come from diverse backgrounds, study a wide variety of subjects in the university and less than 40% of teachers who teach mathematics have teacher certification in mathematics education. The results also showed that teachers who have less than three years of experience and those with more than 10 years experience have different conceptions than those who have between seven and nine years experience.

1. Introduction

The fact that mathematics is an important subject is not gainsaying. Even an ordinary man on the street will agree to this fact. Indeed mathematics is an important and necessary subject for progress in anywhere in the world. It is a subject that cannot be divorced from the world of Technology which is a key to progress and development. It has been aptly described as the queen and servant of all subjects Johnson and Rising (1972) have noted that "… No other subject has greater application than mathematics. It is the prime instrument for understanding and for exploring our scientific, economic, and social world. Today more than ever before, all fields of knowledge are dependent on mathematics for solving problems, stating theories and predicting outcomes. It is an indispensable tool in creating new knowledge."

Nigeria like other developing nations is making a swift move towards technological development. However, any laudable achievement in technological development will be hampered if the potential Scientists, Engineers and Technologists are not equipped with sound knowledge of mathematics. Olorundare (2009) noted "the pursuit of science and the gaining of an understanding of it are seriously hampered if the person concerned is not mathematically secured." And indeed hardly is there anything for which the assistance of the subject (i.e. mathematics) is not sought.

Given the place of mathematics in the development of a nation, the teaching of the subject should be emphasized at all levels of the education system by professionals. If mathematics teaching is to be effective, the pre-service training of teachers must be very sound, while they also need to be exposed to in-service training at regular intervals. Where teacher preparation is inadequate it will lead to teaching failure in the classroom; this is an area that needs to be improved upon. Bello (2007: 4) pointed out that "Education authorities at all levels – national, state and local, have not paid adequate attention to the training and professionalism of teachers of science and mathematics".

Professionalism in teaching is not as straight forward to define as professionalism in more elite expert professions such as medicine and law that are commonly identified with professional status. Pratte and Rury (l99l) describe professionalism in teaching as a craft profession, built on a conscience of craft, rather than a more conventional ideal professionalism. They are indicating that professionalism in teaching is different from more expert professionals and they provided reasons why this is so. They argued that whereas expert professionals are required to have formal knowledge to perform their duties, the teacher profession needs only experience knowledge to perform their duties. They emphasized that teachers have a higher possibility of gaining informal knowledge on their job rather from professional training programs as it is obtained in such professions as law and medicine, Also the teaching profession pays relatively less than the expert professions and because of this it is not recognized in the eyes of the public as a profession with prestige. Shon (2006) defines professionalism as an ideal to which individuals and occupational groups aspire, in order to distinguish themselves from other workers. He outlined three characteristics of a profession:

(i) It must have a distinctive body of knowledge-expert knowledge to do what they do

(ii) It must have membership control-should be able to define and enforce professional standard practice. They should be able to control the education and licensing process of its members

(iii) Be committed to the welfare of the client-have code of ethics in the professional practice usually established by the professional association and enforced by peers in the profession

In the teaching profession Pratte and Rury (1991) recommended that professionalism in teaching should require teachers to be well prepared during their pre-service program and the standards for entry into the teaching profession should be required by school system. Professionalism in teaching can also be viewed in terms of teacher interaction with students as well as teacher interaction with teachers and supervisors (Right, 2008). Teacher interaction with students deals with impartial teaching and appropriate teaching of students regardless of their background, academic performance or personality.

The professional teacher works hard to establish an equitable and safe classroom in which all students feel cared for and fairly treated. If we agree with Right (2006) that professionalism in teaching refers to teacher interaction with students as well as teacher interaction with other teachers and supervisors, then it becomes imperative to explore how much professionalism is exhibited by secondary school mathematics teachers since this has direct implications in improving secondary school students' achievement in mathematics.

Most criticisms of the prevalent poor performance in mathematics by secondary school students usually focus on such factors as negative attitude and lack of interest (Esan, 1999; Amazigo, 2000) and anxiety towards mathematics (Omosigho, 2002) on the pan of the students and ineffective teaching method (Oyedeji, 1992). Surprisingly, not much attention has been paid to the professionalism traits of their teachers. ln dealing with professionalism, the authors of this paper related it to what teachers' conceptions of problem solving, an important variable in any attempt to address poor performance in secondary school (Aina, 1986; Olorundare, 1989; Ale, 1989). The conceptions of problem solving were operationalized using the method popularized by Schoenfeld (1992), Wilson, Fernandez, and Hadaway (1993), Posamentier and Krulik (1998), and Altun and Inemnum (2008) which involved asking questions on teachers' knowledge and understanding of problem solving, This research project was designed to among other things to chart the demographic profile of secondary school mathematics teachers in the context of their dispositions to professionalism, knowledge of and attitude towards problem solving. The objective was to:

1. Chart a demographic profile of teachers using the key variables of gender, length of teaching experience, subject of study in the university, and highest academic qualification.

Research Questions:

This study sought to answer one research question and test two hypotheses:

1. What is the profile of teachers who teach mathematics in secondary school in Taraba state, Nigeria?

Research Hypotheses: The hypotheses were tested at alpha = 0.05

1. There is no significant difference among teachers' mean conception of mathematical problem solving across teaching experience levels (Ho1)
2. There is no significant relationship between the proportion of teachers' responses on their conception of mathematical problem solving and academic qualification (Ho2).

Method

The sample for this study was 327 secondary school mathematics teachers who completed a 32-item questionnaire that elicited information on their biographies, knowledge of, attitude towards, and extant teaching approaches as they related to problem solving instructions.

The respondents were selected using a multi-stage sampling procedure. The first stage was the selection of 10 Local Government Areas states in Taraba state (LGAS) using the stratified random sampling method with education zone as the unit of stratification. The second stage was the random sampling of teachers who teach mathematics in the selected secondary schools. Four schools were selected from each of the selected LGAs through a stratified random sampling using the school type as the unit of stratification. This yielded a total of 60 secondary schools. The third stage was sampling of teachers. The exploratory nature of this study demanded the use of a comprehensive sampling technique where all the mathematics teachers (327) in the selected 60 secondary schools were used for the survey. A total of 327 questionnaires were administered and 226 of them were returned found useable for data analysis giving a return rate of 69%. Additionally, the teachers were observed to provide supplementary data, since self reported data are known to be biased sometimes.

Data Collection

Data were collected using a self-administered questionnaire called Problem Solving Self Administered Questionnaire (PSSAQ). This was designed, validated and pilot tested by the researchers and it produced a reliability coefficient of 0.78. Four research assistants were recruited and trained to administer the questionnaires, one research assistant for each of the four selected education zones. All the four research assistants were secondary school non-mathematics teachers who were recommended by education officers in the selected education zone. The selection of non-mathematics teachers was intentional to minimize possible influence of research assistants on teachers' responses. The data collection took about four months to cover the 10 LGAs. Jalingo and Gassol LGAs took longer time and there was nothing the researchers could do about it. In the end 226 out of the 327 questionnaires distributed were returned and found useable for data analysis with a return rate of 69%.

Results

Research Question 1: What is the demographic profile of teachers using the key variables of gender, length of teaching experience, subject of study in the university, and highest academic qualification?

Questionnaires were distributed to 327 secondary school mathematics teachers in a total of 60 different secondary schools Taraba state and 226 of them were returned and found useable for data analysis giving a return rate of 69%. The 226 respondents represented a wide range of demographic and school characteristics. There were 98(43.4%) male and 126(55.8%) female teachers who were teaching mathematics in the targeted area who responded to the questionnaire. Two respondents, about 0.9%, did not provide their gender.

The analysis of the discipline area where respondents have their highest degree showed that teachers who teach mathematics come from all imaginable disciplines. There were 83 (36.7%) of them who came from the field of mathematics education (B.Sc, (Ed) B.Sc), , 60 (26.5%) of them majored in mathematics, 15 (6.6%) were from economics, while 12(5.3%) studied computer and agric sciences respectively. Nine respondents, about four percent majored in geography, 5(2.2%) studied chemistry and the remaining 30 (17.4%) teachers came from 18 different fields other than the ones reported above. These fields were: food science, biology, engineering, statistics, special education, biochemistry, physics, economics, business studies, science education, finance and banking, operational research, estate management, accounting, laboratory technology, geology, public administration, and industrial technology. In terms of education zone where respondents were teaching, responses were distributed as follows Jalingo zone 71 (31.4%), Gassol zone 49 (2l.7%), Wukari zone 54 (23.9%), Sardauna zone 52(23%). The respondents taught all across the six arms of secondary school from JSS1 through SSS3 classes. Most responses analyzed came from teachers who were teaching JSS3 50 (22.1%). This was followed by teachers teaching mathematics in SSS3 48(21.2%). The next high responses came from SSS1 teachers 37(16.4%), this was followed by SSS2 teachers 34(15%). At the fifth place, in terms of ranking, were teachers who taught J SS2 32(14.2%) and at the sixth place were teachers in ISS1 24(10.6%).

The respondents have varied length of teaching experiences, 101(44.7%) respondents reported that they have taught rnathematics for more than 10 years. About 29 (12.8%) have taught math for about 7 to 10 years, 47 (20.8%) have been teaching math for about 3 to 6 years and 49(2l.7%) have been in the teaching profession for less than three years. ln terms of highest academic qualification of respondents, 166 (73.5%) hold a bachelor's degree, 23 (10.2%) hold an NCE, 20 (8.8%) have a masters degree while l7(7.5%) have a post-graduate diploma in education (PGDE) `

Hypothesis: 1. There is no significant difference among teachers' mean conception of mathematical problem solving across teaching experience levels

This hypothesis was tested using ANOVA at alpha level of 0.05. The ANOVA result is significant F (3, 222) = 3.2Ol, P = .024; the null hypothesis of no difference is rejected thus, there is a significant difference among teachers' conception of problem solving across experience levels. From Table l also, it is obvious that there is a significant difference between the four means as the mean of 0-3 years experience is much higher than the group of teachers with 7 - 9 years experience. Also there is obvious difference between the mean of 7 - 9 years experience and the mean of 10 years and above.

Table 1: ANOVA of teachers' conception of mathematical problem solving across experience levels.

Experience	N	Mean	SD	DF	F-Value	P-Value
0 - 3 years	51	21.22	2.74	3	3.20	.024
4 – 6 years	47	20.40	3.19			
7 – 9 years	28	19.00	3.28			
≥ 10years	100	20.7	3.28			

A pair-wise comparison of the means was conducted using Turkey test to ascertain which of these means are statistically different. The result is presented in Table 2 below. The Turkey test result in Table 16 shows that teachers who have spent three or less years teaching have a better conception of problem solving from those who have spent seven to nine years. Also teachers who have spent ten years or more teaching mathematics have better conception of problem solving than the group of seven to nine years experience teachers.

Table 2: Result of Turkey test for teachers' conception of mathematical problem solving across teaching experience level (n = 226; α = 0.05)

Experience level Combinations	Mean Difference	Standard Error	Sig.
0 – 3 versus 4 – 6	.8114	. 63655	.581
0 – 3 Versus 7 – 9	2.2157	.74046	.016*
0 – 3 versus ≥ 10	.4557	.54170	.835
4 – 6 versus 7 – 9	1.4043	.75155	.245
4 – 6 versus ≥ 10	-.3557	.55675	.919
7 – 9 versus ≥ 10	-1.7600	.67310	.047*

*Indicates significant results

The results above show clearly that profiling is an important technique in addressing mathematics performance as there are significant differences relating to length in service and knowledge of such an important variable as problem solving.

Hypothesis 2: There is no significant relationship between the proportion of teachers' responses on their conception of mathematical problem solving and academic qualification.

Both the result of the analysis and the contingency table are presented in Table 3. This result shows that teachers who have NCE and post graduate qualifications have better conceptions than those with bachelor's degree. This result was found to be significant using a Chi square test hence we reject the null hypothesis at α = 0.05; X^2 (7, N = 226) = 15.520, p = .000. There is a significant relationship between the proportion of teachers' responses on their conception of mathematical problem solving and academic qualification.

Table 3: Contingency table and chi square for the test of no relation between teachers' conception of mathematical problem solving and academic qualification (n = 226; α = 0.05)

Conception	Academic qualification				Chi Square Test of Significance		
	NCE	Bachelors	Graduate Degree	Total	X^2 Value	DF	Sig
Correct Observed Expected %Within	21 16.6 91.3	108 119.7 65.1	34 26.7 91.9	163 163.0 72.1	15.520	2	.000
Incorrect Observed Expected %Within	2 6.4 8.7	58 46.3 34.9	3 10.3 8.1	63 63.0 27.9			
Correct Observed Expected %Within	23 23.0 100	166 166.0 100	37 37.0 100	226 226.0 100			

Discussion

This study revealed that teachers who teach mathematics come from all imaginable disciplines. The result showed a total of 22 distinct fields of study which are: food science, biology, engineering, statistics, special education, biochemistry, physics, economics, business studies, science education, finance and banking, operational research, estate management, accounting, laboratory technology, geology, public administration, and industrial technology. It is important to note that, not only that majority of these teachers did not major in mathematics; they do not have any teaching certification. This finding supports Wise (1991) who found that sixty percent of American secondary school mathematics teachers did not major in and are not certified to teach mathematics. The result also showed that more female than male teachers teach mathematics at secondary school level, and majority of the teachers hold a bachelor's degree. Quite impressively, many of the teachers profiled have taught mathematics for more than 10 years.

Teaching experience often plays an important role in instructional delivery. In this study, teaching experience presented an interesting relationship with correct conception, with teachers of less than three years of experience being similar with more experienced teachers who have more than nine years experience; both groups have better conceptions than middle-experience teachers (four years to nine years). The fact that teachers who have less than three years experience have better conceptions than those who have between four and nine years lends credence to the saying that new broom sweeps best. Those who have between four and nine years experience could be suffering from burnout or self doubt as to whether they should continue or leave teaching to try other professions or go for higher degrees. It appears also that those who have experience of` ten years and above are settled on their job, have accepted it well, and seems to be putting in their best efforts.

It helps if they have higher degrees or even NCE with many years of experience. Respondents with NCE have similar conception with respondents with graduate degree, and the two groups have significantly better conception than respondents with bachelor's degree.

According to this study, the best years for all teachers are the first three years when they are still enthusiastic and passionately ready to deliver their new knowledge, and the period beyond their ninth year in the classroom when they have probably settled for a career in secondary school teaching.

Conclusion:

The result of this study has serious implications which suggest that many present approaches to addressing the perennial poor performance in secondary school mathematics examinations are inadequate. Instead of focusing mostly on students, classroom infrastructure, and experimental studies to test different teaching methods as is the case now, researchers and mathematics educators should pay attention to professionalism. Government should finance the training and employment of professional mathematics teachers. A situation where only 37% of mathematics teachers studied mathematics education and even less 27% studied mathematics in the university cannot yield the expected high performance in secondary school mathematics examinations, for as Ohuche and Obioma (2003) had found school subjects must be taught by teachers who were trained and certified in those subject. This is the sense in promoting professionalism and if teachers are serious about raising the bar of professionalism in teaching, they must: acknowledge the unique nature of teaching and pay attention to specialization and create standard for teachers.

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