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Sikiru A. Amoo
Federal University Wukari, amooadesina@yahoo.co.uk

Akeem B. Disu
National Open University of Nigeria, modelab4real@yahoo.com

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School Environmental Factors and Mathematics Teaching Effectiveness: Implication for E-Learning

Dr. Sikiru A. Amoo, PhD
Department of Mathematics
Federal University Wukari
Taraba, Nigeria
Email: amooadesina@yahoo.co.uk

Akeem B. Disu
School of Science and Technology
National Open University of Nigeria
Victoria Island, Lagos, Nigeria
Email: modelab4real@yahoo.com

Abstract

Mathematics occupies a central position in the school curriculum. It is a core subject from the primary through the junior secondary to the senior secondary school levels of the educational system. This important position occupied by the subject in the school curricula is borne out of the role of mathematics in scientific and technological development, a sine-qua-non in national building. However, the teaching of this important subject is beset with problems of societal values for it, there is the problem of inadequate and substandard learning materials and general attitudes among others. Therefore, the study investigated the pre-professional mathematics teachers' beliefs about factors that could contribute to the mathematics teaching effectiveness in secondary schools.
A non-experimental study was carried out on the pre-service postgraduate students in Lagos State. Self constructed questionnaires were administered on sampled 115 postgraduate students. The sample consisted of male = 42.6%, female = 57.4%. Two instruments were used for data collection; mathematics teachers effectiveness scale (α= 0.782) and the likelihood for the occurrence of effectiveness factors happening in schools scale (α = 0.806). The collection of data lasted three weeks. The data collected were analysed using descriptive statistics, t-test and analysis of variance.

The pre-professional mathematics teachers were identified with factors contributing to their teaching effectiveness, there was significant difference in their perception of effectiveness. The respondents were not wholeheartedly disposed to effectiveness factors occurring in their place of work but were of the opinions that some might happen in their schools on the long run. There was a significant composite effect of predictor variables to pre-service teachers' views of mathematics teachers' effectiveness and the likelihood for the factors occurring in their schools. There was a significant composite effect of predictor variables to pre-service teachers report ($F_{(3, 112)} = 3.245$, $P<0.05$).

Therefore, there is the need to increase the level of awareness of society on the relevance and importance of mathematics. The teachers should put up the reasons for making the mathematics recognised in the society and across the globe in order to increase the students' achievement in the subject.

Introduction

The origin of mathematics as a core subject in secondary school system may have been an attempt by the policy makers to solve certain quantitative problems of human's daily life. Today, the importance of mathematics permeates all aspects of human endeavour (Ilori, 2003). Mathematics as the queen of science cannot be completely separated from sciences because of its applications to physical sciences. Increasingly, applicants for the best employment opportunities will need a good grasp of science, mathematics, and computer technology. However, the societal values and views about its importance among the school subjects have not been fully explored. Why this is so, and what can be done to increase their achievement, are important educational concerns now. Successful attempts to teach mathematics effectively have been made recently, and a range of educational policies, programmes, school effectiveness and methods for effective instruction have been identified (Oyedeji, 2000; Adewale and Amoo, 2004).

The recent push for accountability based on students' achievement, by means of standardized testing, has resulted in the realization that students are not performing as well as expected in spite of the huge amount being expended to improve infrastructure, retraining teachers and raising the status of the teaching profession (Amoo, 2011). This gap is even more pronounced in the area of mathematics. Many factors contribute to poor performance on students' achievement. Among these are family values and climate, school environment, teachers' factors, society's view about mathematics, peer pressure, and test-taking anxiety. At another dimension, students' judgment of their capability to accomplish a task or succeed in an activity, or self-efficacy, is a key factor. Self-efficacy beliefs help determine how much effort a student will expend and how much stress and anxiety they will experience as they engage on a task. Teacher efficacy beliefs, a teacher's perception of how effectively they can affect student learning, have also been found to have a great impact on their self-efficacy, and therefore the achievement of their students. In as much as we want to remediate the problems facing the teaching and learning of mathematics, such factors like teachers' characteristics, their teaching effectiveness and school environmental factors that promote teaching effectiveness are important.

On the other hand Adewale (2010) states that one of the measures of school effectiveness that has stood the test of time is student's achievement. There seems to be a relationship between school effectiveness and school quality. The studies of Farombi, (1998); Onwuakpa, (1998) and Fabayo (1999) deal with school quality. While school quality is looking at the level of material inputs allocated to schools on a per pupil level and the level of efficiency with which fixed amounts of material inputs are organized and managed to raise students' achievement (Fuller, 1986). School effectiveness is interested in such variables as: instructional leadership provided by the school head, curriculum - learning objectives, learning activities, and achievement measures (Adewale 2004). Others are monitoring of pupils and pupils attendance, discipline and school climate, expectations for quality work supported by staff and pupils, existence of school and community partnership programmes. However, the indicator of school effectiveness that is so obvious to the society is the *product of schooling*, (that is, the achievement level of the students in examinations). If a school produces students with high grades, the school is often tagged effective while a school that cannot turn out students with high grade may be regarded as an ineffective one.

It appears that definition of school effectiveness is a complex task, one which should be expressed in terms of qualitative variables (school climate, instructional leadership, high expectations, etc.) as well as quantitative variables (achievement scores). The different methods used to measure school effectiveness can be analyzed along four basic dimensions: (1) level of aggregation; (2) criteria of effectiveness; (3) time frame of analysis; and (4) population. The patterns that have emerged in studying schools as complex social systems reveal a set of distinct characteristics in high-achieving schools. These factors include: (1) strong administrative leadership, particularly in the area of curriculum and instruction; (2) an orderly, safe environment conducive to learning; (3) a pervasive and broadly understood instructional focus emphasizing a commitment to basic skills; (4) teacher behaviours that convey the expectation that all students must obtain at least minimum mastery; and pupil achievement as the basis of programme evaluation. If our children are to achieve levels of productivity, citizenship, and personal comfort that exceed our own, they will have to be better educated. Much of that improved education must be provided in schools through a teacher's guidance. Therefore, our schools must become more effective to be able to carry out these functions (Owen, 2004).

School effectiveness researchers' aim is to ascertain whether differences in resources, processes and organizational arrangements affect student outcomes, and if so in what way. Most educators would agree with Leithwood, Jantz &

Steinbach (1999) when they concluded that conceptualizing effectiveness in terms of standardized achievement test scores was too narrow because it ignored all the effects of schooling, and the wider range of cognitive and affective variables that were essential outcomes of school effectiveness but could not be reflected by a test score. It is argued in another way that while the above observation is true, the reality of the politics of schooling demands a tangible measure that can be looked at comparatively and until more measures are ascribed to other desirable outcomes of schooling, and assessment of the psychometric properties of those outcomes are in place, students' achievement and competences would remain the yardstick by which schools are judged effective. Additionally, some variables such as: teachers' characteristics and school environmental factors have been reported to have impact on students' achievement (Amoo, 2000)

Much of the research into mathematics education in recent years has been driven by concerns about students' achievement in mathematics. In response to these concerns there has been a refocusing of attention on the teacher (Ilori, 2003). Teacher effectiveness has come under the microscope; reforms in teaching standards have been formulated and teacher professional development has been re-thought (National Council of Teachers of Mathematics, 2000; Zaslavsky, Chapman, & Leikin, 2003).

The study reported in this paper investigates pre professional or service teachers' views of the school environmental factors that have contributed to improvement in their teaching of mathematics. This study was designed to enable all of the preservice teachers attending postgraduate training programme in education to express their concerns about the effectiveness of mathematics instructions.

Research into teacher effectiveness in mathematics teaching has suggested that there are significant differences among teachers (Amoo, 2000; Adewale & Amoo, 2004). Sullivan and McDonough (2002) found evidence that children from similar backgrounds had markedly different experiences at school. The different experiences could only be attributed to differences among teachers. Similar results were reported by Siemon, Virgona, & Corneille (2001, p. 99) in a Victorian study of middle schools in which they found that there was as much difference within schools, that is from class to class, as there was between schools in student achievement. This suggests that individual teachers make the difference.

The increasing focus on developing teachers' abilities to deliver high quality student outcomes means that attention must be devoted to the issue of what constitutes effective professional development when considering the differences between teachers. We are becoming much more aware of what effective teachers of mathematics do in their classrooms (Askew, Brown, Rhodes, William, & Johnson, 1997; Reynolds & Muijs, 2000) and the debate over what teachers should know to be effective teachers of mathematics continues (Carpenter, Fennema, Franke, Levi, & Empson, 2000; Lowery, 2002,).

In Nigeria and all over the world, educational experience and training in diverse knowledge and skills prepare one to face challenges in life. Individuals then become empowered to modify their environment to meet their needs and desires which is in line with policy on education (Adepoju & Amoo, 2005). In order to achieve educational goals and mathematics teaching effectiveness, improving the quality of education is a critical issue, particularly at a time of our educational expansion and reforms. One of the ways to achieving quality in our education is not to undermine the impact Information and Communication Technology (ICT) in our school system as stated in the policy (FRN, 2004). We should now take that advantage of e-learning to explore the current trends in the mathematics teaching and the enabling factors that can promote school effectiveness.

With the emergence of ICT in the classroom, Amoo (2010) opines that if ICT facilities integrated in junior and senior secondary schools are of good quality and the students have access and utilise the facilities, there is hope that the attitudes of students would change; there might be improved motivation towards learning school subjects (mathematics inclusive). This is equally a function of how mathematics teachers effectively employ the ICT facilities in helping students in their classroom.

There are also speculations that teachers vary in their perception of effectiveness culture as well as classroom practices (Adewale, 2004; Amoo & Rahman, 2004; Amoo & Onasanya, 2010). These variations must be as a result of some factors. Does the way teachers teach affect students in the classroom? Does the way the teachers interact with pupils/students portray good classroom culture and practice? This calls for empirical verification. To bridge this gap, it is critical to sensitize teachers of mathematics about the importance of mathematics teaching effectiveness. In the era of technological advancement and clamour for attainment of MDGs, there is a need to have functional educational system that is inclusive of e-learning in our school system. Towards this end the following research questions were included.

Research Questions

1. Is there significant difference in pre-professional perceptions of factors for their mathematics teaching effectiveness?
2. Is there significant difference in pre-professional perceptions of factors for the likelihood of occurrence of mathematics teaching effectiveness in their schools?
3. Is there significant difference in the pre-service teachers' views of the factors for teaching effectiveness and likelihood for factors taking place in their schools?
4. To what extent would pre-service teachers' gender, qualification and years of experience predict mathematics teachers' effectiveness?

Methodology

The study adopts an ex-post facto research type because of the exploratory nature of the work. The independent variables (gender, qualification and year of experience of preservice mathematics teachers are not in any way manipulated. A sample of 115 Postgraduate Diploma in Education students participated in the study. The teachers are from private and public services on the self-professional development programme with different background, qualifications, age, and other characteristics were selected for the study.

Instrumentation

The researchers designed two instruments based on their experience in mathematics education and school effectiveness. The two instruments consist of 28 items each. The two instruments were divided into demographic background and profile factors for the school environmental factors that could enable mathematics teaching effectiveness and the likelihood of such factors occurring in their schools to enhance mathematics teaching effectiveness. The school environmental factors that can bring about mathematics teaching effectiveness was constructed and scored on 5 –point Likert's -like options that is 5 = Strongly Agree, 4 = Agree, 3 = Undecided, 2 = Disagree and 1 = Strongly Disagree. The instrument showing the likelihood of those factors occurring in school was scored based on 5 point scale: that is 5= very likely, 4 = somewhat likely, 3 = neither, 2 = somewhat unlikely and 1 = very unlikely. Using Cronbach's Alpha Reliability statistics for two instruments produced 0.79 and 0.80 for N= 50 respectively. The experts in the field of mathematics education and school effectiveness, who have experience of both secondary and tertiary pedagogy, validated the instruments.

Procedure

The researchers personally administered the instruments on the Postgraduate Diploma in Education students. They were asked to respond to the questionnaire bearing in mind the way they teach these children to attain teaching effectiveness and the likelihood of such occurring in their schools in the following academic year.

Results and Discussion

Research Question One: Is there significant difference in pre-professional perceptions of the profile factors for mathematics teaching effectiveness? In order to answer the question raised for the study there is need to consider the Table 1which presents the summary of the respondents using ANOVA

Table 1: Analysis of Variance[b] of Factors that would enable pre-professional effective Mathematics teacher

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	41194.770	28	1471.242	61.087	0.000[a]
	Residual	1974.923	87	24.084		
	Total	43169.694	115			

a. Predictors: (Constant), Motivating students to learn (competitions, awards), Team teaching and planning with other teachers on how to teach mathematics, Provision for state and national guidelines on mathematics education (standard, goals, curriculum, objectives), Extended class period length (block scheduling), Conducive classroom, physical environment (room size, proper furniture, sinks, etc), Increased funding, A decease in your teaching workload, Adequate provision for mathematics equipments, Provision of hands-on maths kits, teaching materials, An increase in students' academic abilities, Availability for individual self help / academic support from professors/mathematics educators, Support from other teachers (coaching, advice, mentoring, modelling, informal discussion etc, Community involvement through provision of resources, counselling services and financial support, Support from school administrators, A reduction in number of subjects you are required to teach, Responsiveness of our educational system to learners' needs, interests, Involvement of the state board of education/ministry, True suggestion/feedback from learners, Reduced class size (number of pupil/students) , Reinforcing students experiences through field trips/excursion and visitations, Establishing guidelines for appropriate classroom assessment strategies, Provision for frequent laboratory practical work, Adequate professional staff development on teaching mathematics (workshops, conferences, etc), Adequate provision of mathematics curriculum materials (lab manual activities, books, etc), Teaching mathematics teachers about learners centred instruction (adaptability of content/objectives to learners' interest and needs), Active parental involvement through monitoring /feedback mechanism on learners progress in mathematics, Provision of Technology support (computer, software, internet facilities), Appropriate use of knowledge of modern mathematics teaching methods

b. Dependent Variable: Factors for effectiveness as teacher

Table 1 shows the level of agreement with the factors that could make the mathematics teachers effective in the classroom and practice of the pre-professional teachers in schools. All the 28 items were recorded to be significant. The result using ANOVA was statistically significant at $P< 0.05$. Those significant differences are indications and pointers to the earlier findings that the professionals are to be allowed to teach mathematics at this level and those who are yet to have pedagogical knowledge of the subject matter and not yet planning to effective should be encouraged to do so. These findings support the earlier findings on the need to allow the combination of content and professional pedagogy in the mathematics classroom (Ilori 2003; Adewale, 2004; Amoo & Efunbajo, 2004; Adeleke & Amoo, 2007; Amoo & Onasanya, 2010).

Research Question Two: Is there significant difference in pre-professional perceptions of the profile factors for the likelihood of occurrence of mathematics teaching effectiveness in their schools? In order to answer the question raised for the study there is need to consider the Table 2 which presents the summary of the respondents using ANOVA

Table 2: ANOVA[b] of likelihood that effectiveness factors will occur in the school

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	14093.554	28	503.341	0.761	.790[a]
	Residual	54878.411	87	661.186		
	Total	68971.964	115			

a. Predictors: (Constant), Motivating students to learn (competitions, awards), Team teaching and planning with other teachers on how to teach mathematics, Provision for state and national guidelines on mathematics education (standard, goals, curriculum, objectives), Extended class period length (block scheduling), Conducive classroom, physical environment (room size, proper furniture, sinks, etc), A decease in your teaching workload, Increased funding, An increase in students' academic abilities, Adequate provision for mathematics equipments, Availability for individual self help / academic support from professors/mathematics educators, Provision of hands-on maths kits, teaching materials, Support from other teachers (coaching, advice, mentoring, modelling, informal discussion etc, Community involvement through provision of resources, counselling services and financial support, Support from school administrators, A reduction in number of subjects you are required to teach, Responsiveness of our educational system to learners' needs, interests, Involvement of the state board of education/ministry, True suggestion/feedback from learners, Reduced class size (number of pupil/students) , Reinforcing students experiences through field trips/excursion and visitations, Establishing guidelines for appropriate classroom assessment strategies, Provision for frequent laboratory practical work, Adequate professional staff development on teaching mathematics (workshops, conferences, etc), Adequate provision of mathematics curriculum materials (lab manual activities, books, etc), Active parental involvement through monitoring /feedback mechanism on learners progress in mathematics, Teaching mathematics teachers about learners centred instruction (adaptability of content/objectives to learners' interest and needs), Provision of Technology support (computer, software, internet facilities), Appropriate use of knowledge of modern mathematics teaching methods

b. Dependent Variable: Likelihood for factors occurring in school

Table 2 shows the level of commitment to the occurrence of school environmental factors that could promote effectiveness the pre-professional teachers in schools. Out of 28 items, only 9 items were recorded not to be significant. From the analysis we observe that the respondents' opinions differ in what they all regard as likelihood of the occurrence of such pertinent issues of teaching effectiveness. Those significant differences are indications and pointers to the earlier findings that the professionals are to be allowed to teach mathematics at any level and those who are yet to have pedagogical knowledge of the subject matter be encouraged to do so. The ANOVA was not statistically significant at $P< 0.05$.

These findings support the earlier findings on the need to allow the combination of content and professional pedagogy in the mathematics classroom (Amoo & Efunbajo, 2004, Adeleke & Amoo, 2007).

Research Question Three: Is there significant difference in the pre-service teachers' views of the factors for teaching effectiveness and likelihood of such factors taking place in their schools? In order to answer the question three, there is need to consider Table 3

Table 3 The significant difference views and likelihood of effectiveness factors taking place in their schools

Variable	Mean	N	SD	S.E. M	t	Df	Sig (2-tailed)
Effectiveness	118.3	115	20.1	1.87	6.3	113	0.000
Likelihood of occurrence	101.6	115	25.8	2.41			

Statistically significant at P< 0.05

The table shows the significance at two-tailed at 95% confidence interval. The in-service teachers were of the views that that most of the issues raised for the teachers being effective are likely to occur in their schools in the subsequent seasons.

Research Question Four: To what extent would pre-service teachers' gender, qualification and years of experience predict mathematics teachers' effectiveness? In order to answer the question four, there is need to consider Tables 4 and 5 below

Table 4: The extent at which in-service teachers' gender, qualification and years of experience predict mathematics teachers' effectiveness

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.234 [a]	.055	.038	19.67048

a. Predictors: (Constant), years of experience, qualification and gender

Table 4 showed the contributions of pre-service teachers' gender and years of experience to their effectiveness and likelihood of such happening in their schools. These jointly contributed 3.8% to the effectiveness. To further the directions of the contributions there is need to consider Table 5. It shows the analysis of variance and this gives significant contributions.

Table 5: Analysis of Variance

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	2510.803	3	1255.402	3.245	.043 [a]
	Residual	43335.927	112	386.928		
	Total	45846.730	115			

a. Predictors: (Constant), years of experience, qualification and gender

b. Dependent Variable: Factors for effectiveness as teacher

The analysis of variance indicated above shows $F_{(3, 112)} = 3.245$ which invariably significant at 0.05 level. The results of this study are indications that experiences, qualifications and gender are important and should be considered when we mention mathematics teaching effectiveness. The findings corroborate the studies of (Amoo, 2000, Amoo & Rahman, 2004; Adeleke & Amoo, 2007).

Recommendations

The results of this study assisted the researchers to report that the profiles of in-service teachers are important when considering the teachers effectiveness in our schools as well as their dispositions to effectiveness in their various schools. This study is by no means perfect as it is open to other interested researchers to verify the study at this level of education. This can be done at other geographical locations using the same instrument or other variables which may equally be modified. In order to attain the MDGs standard in ICT and global cooperation, the issues identified to make the mathematics teachers effective in the school and classroom environment should be put into practice.

Implication and Conclusion

This study can assist the teachers, curriculum planners and mathematics educators and evaluators in directing the best way to impart knowledge of mathematics in such a way that will improve the present standard at any level of our educational system. It can assist in planning school effectiveness. It can assist pre-professional mathematics teachers to explore the advantages of e-learning to learn the new methods of teaching mathematics, as well as designing various strategies that promote effectiveness. It hoped that the readers and stakeholders in education and those who believe school environmental factors that can promote teaching effectiveness will find this study beneficial as such assist to maintain factors that promote effectiveness culture in dealing with students.

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