
PROFESSIONAL DEVELOPMENT OF MATHEMATICS TEACHERS AS A TOOL FOR MOTIVATING STUDENTS' INTEREST AND PERFORMANCE

¹Odafe, Robert ²Surakat, Hameed I. & ³Bakre, Fatimah Omolara

¹*Department of Science and Technology
Faculty of Education University of Lagos, Akoka.*

²*Department of Science and Technology
Faculty of Education Northwest University Kano.*

³*Department of Mathematics/Statistics
Federal College of Education, (Tech) Akoka, Lagos*

Abstract

The challenges facing African nations such as in politics, economic, social and all other fields in the society can be traced to our low standard of education. This research work deems fit to gear mathematics teachers towards the goals, objectives of teaching mathematics, understand what effective mathematics teaching looks like and how to effectively teach this subject so that students performances will be improved and they will develop an undiluted interest for the subject. The lack of students' motivation and poor performances of students towards mathematics could be associated to the teachers' lack of professional development. The general objective of this study is to examine how professional development of mathematics teachers can be a tool for motivating & enhancing students' interest and performance in mathematics. Efforts were made in the paper to present the contribution of mathematics in all facets of human lives as a way forward to the problem of under-development in most countries in the continent of Africa. This paper addressed the issue of mathematics teachers' in-service training and other professional development as a direct influence on the student's performance in mathematics. It was therefore concluded that if mathematics teachers see professional development as a constant routine and as a key to their success in the teaching/learning process, this will not only motivate but it will enhance mathematics students' interest and their performances in the subject. At the end, various ideas were suggested as recommendations for the growth of the societies in general.

Keywords: *Motivation, Effective teaching, Interest and Professional development.*

Background to the Study

Mathematics can be defined as a science of patterns and order which relies on logic, employs observation, simulation and experimentation as its means of discovery. These features make it possible for man to possess a distinctive mode of thought which allows him to be versatile and powerful in giving exact interpretation to his ideas and conclusions. That is, the numerical and calculation part of man's life and knowledge.

<http://internationalpolicybrief.org/journals/edu-and-science-journal-vol5-no1>
ISSN PRINT: 2315-8425, ONLINE 2354-1660

Without a bias mind, mathematics is a practical discipline that plays a predominant role in our everyday life. In lieu of this, it has become an indispensable factor for the progress of our present day world.

“Mathematics reveals hidden patterns that help us to understand the world around us. Now, much more than arithmetic and geometry, mathematics today is a diverse discipline that deals with data, measurements and observations from science, with inference, deduction, and proof; and with mathematical models of natural phenomena, of human behavior, and of social systems.” From *Everybody Counts: A Report to the Nation on the future of Mathematics Education* (c) 1989 National Academy of Sciences.

Anthony and Walshaw (2009) opined that mathematics is the most international of all curriculum subjects, and mathematical understanding influences decision making in all areas of life- private, social, and civil. Student's performances have been poor in mathematics especially in Senior School Certificate Examination (SSCE) Nigerian Educational Research and Development Council (NERDC), 1992; Salau, 2002 in Daso, (2012)). Some of these problems according to Science Teachers Association of Nigeria (STAN) (2002) cited by Daso (2012) are: Acute shortage of qualified professional mathematics teachers, exhibition of poor knowledge of mathematics content by many mathematics teachers, overcrowded mathematics classrooms, adherence to odd teaching methods in spite of exposure to more viable alternatives and students' negative attitude towards mathematics.

With reference to the statement” Mathematical competence opens doors to productive futures and lack of mathematical competence hence keeps those doors closed” quoted from National Council of Teachers of Mathematics (NTCM) in 2000, it is therefore imperative for mathematics teachers across African Continent to be reminded of the aims of teaching mathematics, understand what effective mathematics teaching looks like and how to effectively teach this subject in order to motivate the students.

Objective of the Study

The objective of this study is to find out if the professional development of mathematics teachers can be a tool for motivating student's interest and performance in mathematics.

Literature Review

The main aim of education is majorly to impart values to all and sundry based on the needs and purposes of the society for achieving growth and development. These can be further realized through various subjects of the school curriculum. For mathematics, the teaching of mathematics according to Rachna (2012) is not only concerned with the computational know how of the subject but is also concerned with the selection of the mathematical content and communication leading to its understanding and application.

According to Sidhu (1995), the goals of teaching mathematics are; to develop the mathematical skills like speed, accuracy, brevity, estimation, etc, to develop logical thinking, reasoning power, analytical thinking, and critical-thinking, to develop power of decision-making, to develop the technique of problem solving, to recognize the adequacy or inadequacy of given data in relation to any problem, to develop scientific attitude i.e. to estimate, find and verify results, to develop ability to analyze, to draw inferences and to generalize from the collected data and evidences, to develop heuristic attitude and to discover solutions and proofs with the own independent efforts and to develop mathematical perspective and outlook for observing the realm of nature and society.

In the light of the view point of Curriculum Development Committee (CDC), Hong Kong (1999), mathematics curriculum aims at developing students'; ability to conceptualize, inquire, reason and communicate mathematically, and to use mathematics to formulate and solve problems in daily life as well as in mathematical contexts, ability to manipulate numbers, symbols and other mathematical objects, number sense, symbol sense, spatial

sense and a sense of measurement as well as the capability in appreciating structures and patterns and positive attitude towards mathematics and the capability in appreciating the aesthetic nature and cultural aspect of mathematics.

It is quite conspicuous that one aim of mathematics is to develop students' positive attitude towards the subject. This can only be done if the teachers who are to handle the subject are professionally prepared to teach it in a way that will not bring about a calamitous end in the students interest about the subject. From the personal experience of the writers of this articles, students have always complained that they don't like the subject called 'mathematics' and they have no driven factor to enable them see a light about the usefulness of the subject. This may have contributed to one of the reasons that has made student's performance in mathematics dwindled in Nigeria.

With reference to the above subject matter, an effective mathematics teacher should, when teaching mathematics use the teaching methods, strategies and pedagogic resources that are much more fruitful in gaining adequate motivation and responses from the students.

What then is Effective Teaching?

The teaching and learning of mathematics is a complex activity and many factors determine the success of this activity. The nature and quality of instructional material, the presentation of content, the pedagogic skills of the teacher, the learning environment, the motivation of the students are all important and must be kept in view in any effort to ensure quality in teaching-learning of mathematics.

With regard to the effectiveness of their practice, the National Research Council (1989) cited by National Council of Teachers of Mathematics (1991) stated that "Effective teachers are those who can stimulate students to learn mathematics... to understand what they learn, they must enact for themselves verbs that permeate the mathematics curriculum; 'examine', 'represent', 'transform', 'solve', 'apply', 'prove', 'communicate'. This happens most readily when students work in groups, engage in a discussion, make a presentation, and in other ways take charge of their own learning.

The teacher competences are important; they include encouraging students to discuss their mathematical ideas, working cooperatively, commenting on others' ideas, explaining their own strategies/solutions, directing students to solve problems by themselves, discussing mathematical problems, applying new approaches/methods, and not necessarily giving a final solution but instead asking more (probing) questions. These indicators reflect a student-centered approach to teaching and learning mathematics (Turmudi, 2012).

Farmer, Gerretson, and Lassak (2003) noted that, "one of the two core premises from the Glenn report (US Dept of Education, 2000) is that better teaching is the lever for change and effective professional development is the indispensable foundation for high quality teaching" (p. 331).

Therefore, we define an effective mathematics teacher as one where all the conversation is about the mathematics, the students are engaged and there is not too much teacher talk.

Characteristics of an Effective Mathematics Teacher

The concept of effective teaching in mathematics among the scholars has accentuated the differences in the beliefs of teachers across the globe. The idea focuses on how well the teacher prepares and presents a lesson and the ability to provide clear explanations of the points to be covered in the lesson in order for the stated objectives to be achieved at the end of every mathematics lessons. We therefore propose the following to be observed in every mathematics lessons in order to stimulate the students towards achieving better performance in the subject.

Establishment of mathematical voice: This is a concept that enables a mathematics teacher to create a classroom setting which gives all students the opportunities and expectation to be engaged in the intellectual content of the lesson. It is therefore required of a mathematics teacher to implore a strategy during his lesson to ensure that all students are asked to contribute their ideas vocally. Through communication, ideas become objects of reflection, refinement, discussion, and amendment. Jessica and Elizabeth (2013) proposed that there are two aspects of mathematical voice that should be understood. These are: Mathematical voice in the classroom and mathematical voice in the society.

Good Mastery of the Subject: A well-grounded knowledge and understanding of the subject are crucial elements to effectively teach mathematics. This will possibly assist the mathematics teacher to identify the difficult concepts the students are facing and thereby paving way for the teachers to devise instructional strategies to overcome the difficulties. In addition to this, he should have thirst for knowledge on a continuous basis.

Proficient in the Use/Choice of Instructional Aids: It is not an understatement that learners of today are growing up in a world of advance technological tools and mass media. These include Programmed Learning Material (PLM), Manipulative or Models, Charts, Graphic calculators, Motion Pictures, Computer and Television, etc. So, it is of necessity to use the aforementioned resources for the purpose of enhancing the learning of the students and as well as making the lessons to be relevant to the current society. As a result of this, an effective mathematics teacher should possess the skills needed to properly choose and instruct the learners with these tools as instructional materials.

Showing Concern Towards the Students: An effective teacher of mathematics should know and care for his students. This will not only builds a positive rapport between the teacher and the students but also could directly have impact on students' learning.

Extracurricular Activities: There are several activities a mathematics teacher can adopt during his lesson in order to contribute to the development of a better mental attitude towards mathematics among the learners. Rachna (2012) proposed the following activities as contained in the chart below to foster students' active role with the main aim of generating knowledge.

Table

NAME OF THE ACTIVITY	EXAMPLES/SITUATIONS WHERE ACTIVITY CAN BE USED
Quiz Competition	Logic, Properties of Numbers, Mathematical Rules and Results
Projects	Contribution by Different Mathematicians
Role Play	Arithmetical Concepts like Profit & Loss, Simple & Compound Interest
Seminars	Shortcuts through Vedic Mathematics, Application of Mathematics in other Disciplines
Discussion	Properties of 'Zero', Difference between Rational and Irrational Numbers, Relating Different Concepts in Mathematics
Mathematics Clubs	Application of the concept studied, Preparing Models, Paper Folding (Origami)
Assignment	Self-Study, Extension of Knowledge
Field Trips	Experiencing the Functional use of Mathematics in Bank and Insurance Company

Extracted from Rachna (2012)

Classroom Management: The leadership style of a mathematics teacher in the classroom has a significant role to play in the performance level of his students. This seemed to be much more important to the teachers. Without it, little or nothing will be accomplished. These include good organization and class control, the use of reinforcement and punishment where necessary, cooperation, sound preparation, teacher's attitude and lots more. Odumosu (1999) suggested the following traits as responsibilities a teacher should possess as manager in the classroom: An embodiment of authority, a good disciplinarian, a good decision maker and a good judge.

Problems Associated with the Teaching and Learning of Mathematics

There is no teaching and learning process that does not have a problem; the system however only needs to adopt strategies that can reduce whatever problems that are associated with the teaching and learning process. The fear of mathematics as a subject by students in Nigeria has always existed and this has been one of the root cause why performances by students in the subject has always been poor according to some researchers (NERDC, 1992; Salau, 2002 in Daso, (2012), Ezeugwu & Igbo (2014)).

Therefore, student's poor performance in mathematics may be caused by some factors according to NERDC (1988) and (CDC) (1995) which are: Lack of interest in the subject, lack of basic knowledge of aspects of subject, gender issues associated with learning environment, home factors in learning of the subject, teacher related factors and students' teachers related factors and poor background of students in the subject resulting from their inability to know early enough the importance of mathematics in the modern world of science and technology. (FRN 2004 in Ezeugwu & Igbo (2014)).

Mathematics Teacher's Professional Development

Garet, Porter, Desimone, Birman and Yoon (2001) asserted that, to carry out the demands of education reform, teachers must be immersed in the subjects they teach, and have the ability both to communicate basic knowledge and to develop advanced thinking and problem-solving skills among their students. Many teachers learned to teach using a model of teaching and learning that focuses heavily on memorizing facts, without also

emphasizing deeper understanding of subject knowledge (Cohen, McLaughlin, & Talbert, 1993; Darling-Hammond & McLaughlin, 1995; Porter & Brophy, 1988 cited by Garet et al.). Mathematics Teachers should not only be versatile in the curriculum content but should also place emphasis on the way they teach the subject and how the students they teach also learn the subject. This may be achieved if teachers of mathematics have undergone comprehensive professional training; this will then enable them understand how they interact in their classrooms. Walker (2007) asserted that good professional development for elementary teachers should effectively address the problem of enhancing teachers' content knowledge.

As cited by Walker (2007), Echoing the recommendations of NCTM (2000) and AMS (2001), Frykholm (1999) urges that teachers must understand mathematics deeply themselves if they are to facilitate the types of discussions and handle the various questions that emerge when learners are engaging in authentic mathematical experiences.

To be effective, professional development must provide teachers with a way to directly apply what they learn to their teaching. Research shows that professional development leads to better instruction and improved student learning when it connects to the curriculum materials that teachers use, the district and state academic standards that guide their work, and the assessment and accountability measures that evaluate their success (Cohen & Hill, 2001; Garet et al. 2001.).

Motivation and Interest

The extent to which social and environmental factors allow a learner to experience feelings of autonomy (as well as competence and relatedness), will influence the quality of motivation expressed by the learner (Vallerand, Pelletier, & Koestner, 2008 in Hartnett, 2009).

Past research studies has shown the role of motivation as a tool in understanding and promoting students' interest and academic performance towards mathematics.

The word motivation according to Pintrich and Schunk (2002) is defined as the process whereby goal-directed activity is instigated and sustained.

Based on intrinsic and extrinsic motivation, Posamentier (2013) suggested nine strategies which can be used to motivate students towards mathematics. These are: Call attention to a void in students' knowledge, show a sequential achievement, discovering a pattern, present a challenge, entice the class with a "Gee-Whiz" mathematical result, indicate the usefulness of a topic, use recreational mathematics, tell a pertinent story and get students actively involved in justifying mathematical curiosities

On the other hand, Hidi and Harackiewicz (2000) described interest as an interactive relation between an individual and certain aspects of his or her environment (e.g. objects, events, ideas). They further established that the key to influencing an individual's academic performance lies in increasing the individual's interest in the particular domain.

Researches in the past have explained how student's interest can be sustained and retained. For instance, a study carried out by Mitchell (1993) in the US found that the two main factors in maintaining student interest over time were the meaningfulness of the task and student involvement. Others include;selection of resources like games, puzzles, hands-on activities etc. that will trigger interest (Hidi & Renninger, 2006), teachers should demonstrate their own interest in the subject matter (Bergin, 1999), the role of textbook in stimulating and promoting student interest in mathematics (Mark, 2011) and so on. Therefore, the end product this practical subject is expected in the learners as stated above cannot be realized until they have a desire and motivation to learn the subject.

Conclusion

Obviously, in this world of technological advancement, every career requires a foundation of mathematical knowledge that will create critical thinking skills which will develop our continent in the areas of politics, economy, social, science and technology, engineering and lots more. It is therefore required of a Mathematics teacher to understand the basic motives already present in their learners so as to enhance the effectiveness of the teaching and learning processes and most importantly to motivate their students' engagement maximally.

Recommendations

No doubt that professional development can influence teachers' classroom practices significantly and lead to improved student achievement when it focuses on students learning the subject matter; instructional practices that are specifically related to the subject matter and how students understand it and consolidating teachers' knowledge of specific subject-matter content. McCutchen et al. (2002) asserted that Teachers who got the extra training spent more time explicitly teaching the basics and their students did better on assessment test.

It is therefore recommended that mathematics teachers should take cognizance of the fact that close alignment of professional development with actual classroom conditions also is key and hence engage in practices that will develop them professionally. This will enable them to understand their students, encourage and mentor them in such a way that will develop their interest in mathematics and as a result enhance their performance. Other recommendations that could hold waters are:

There is need to amend the philosophy underpinning the countries' national policy on education in regards to mathematics curriculum to bring about positive influences on approaches used by teachers during lesson, teaching and professional learning should be improved and supported by both public and private owners in schools and system management, both the government and as well as the private owners should upgrade human capital management and recruit more well-prepared teachers of mathematics at all levels, regardless of socio-economic status of the students, the teacher should ensure to have an effective mathematics lesson and school administrators should arrange daily schedules to allow for common planning times when teachers can meet during the workday. They may also hire substitute mathematics teachers to allow other mathematics teachers to meet in learning teams or to observe peers.

References

- American Mathematical Society & Mathematical Association of America, (2001). "The mathematical Education of Teachers". Providence, RI: Author.
- Anthony, G. & Walshaw, M. (2009), "Effective Pedagogy in Mathematics". International Academy of Education, International Bureau of Education. Educational practices series-19.
- Bergin, D.A. (1999) 'Influence of Classroom Interest' *Educational Psychologist*, 34, 8798.
- Cohen, D.K. & Hill, H.C. (2001), "Learning policy: When state education Reform Works". New Haven, CT: Yale University Press.
- Daso, P.O. (2012), "Strategies for Teaching & Sustaining Mathematics as an Indispensable Tool for Technological Development in Nigeria". *Mediterranean Journal of Social Sciences* 3(15), 77-79. Doi:10.5901/mjss.2012.v3n15p74
- Curriculum Development Committee, Hong Kong. (1999), "Syllabus for secondary schools: mathematics (secondary 1 - 5). Hong Kong.
- Ezeugwu J.O. & Igbo J.N. (2014), "Mathematics as a Tool for re-branding Nigeria: Implications of difficulties in the Teaching & Learning of Mathematics by inexperienced Teachers in Universal Basic Education". *Journal of Education & Practice*, 5(29), 63-72.
- Farmer J. D., Gerretson, H., & Lassak M. (2003) 'What Teachers take from Professional Development: Cases & implication'. *Journal of Mathematics Teacher Education*, 6, 331-360.
- Frykholm, J. (1999), "Elementary mathematics: A Missing Piece in Secondary Mathematics Teacher Education". Paper presented at the Meeting of the Association of Mathematics Teacher Educators. Chicago, IL.
- Garet, M.S., Porter A. C., Desimone L., Birman, B. F. & Yoon, K.S. (2001), "What makes Professional Development Effective? Results from a national sample of teachers". *American Educational Research Journal*, 38(4), 915-945.
- Hartnett, M. (2009), "Factors Undermining Motivation in Place-based Blended Learning: In Same places, different spaces". Proceedings ascilite Auckland: Extracted from <http://www.ascilite.org.conferences/auckland09/procs/hartnett.pdf>
- Hidi, S & Harackiewicz, J.M. (2000) "Motivating the Academically Unmotivated: A Critical issue for the 21st Century" *Review of Educational Research*, 70(2), 151-179.
- Hidi S. & Renninger A. (2006) "The Four-phase Model of Interest development" *Educational Psychologist*, 41, 111-127.
- Jessica, D. & Elizabeth B. A. (2013), "Teaching Mathematics with Women in Mind". *Notices of the American Mathematical Society* 60(9), 1156-1163.
- Mark, P. (2011), "Promoting Student Interest in Mathematics: National Centre for excellence in mathematics & science Teaching & Learning" 2(9)
- McCutchen, D., Abbott, R.D., Green, L.B., Beretvas, S. N., Cox, S. & Potter, N.S. (2002), "Beginning literacy: links among Teacher Knowledge: Teacher practice, & student learning". *Journal of Learning Disabilities* 35(3), 69-86.

Mitchell, M. (1993) "Situational Interest: it's Multifaceted Structure in the Secondary School Mathematics Classroom". *Journal of Educational Psychology*, 85 (3), 424-436.

National Council of Teachers of Mathematics. (1991), "Professional standards for Teaching Mathematics". Reston, VA: USA.

National Council of Teachers of Mathematics. (2000), "Principles & Standards for School Mathematics". Reston, VA: USA.

Odumosu, A.I.O. (1999), "Basic Principles of Education & Methods of Teaching". Ibadan, Nigeria. Olu-Akin Publishers.

Pintrich, P. R., & Schunk, D. H. (2002), "Motivation in Education: Theory, Research, & applications (2nd ed.)". Upper Saddle, NJ: Merrill Prentice-Hall.

Posamentier, A. (2013), "Strategies for Motivating Students in Mathematics". Retrieved from <http://www.edutopia.org/blog/9-strategies-motivating-students-mathematics-alfred-posamentier>.

Turmudi, (2012), "Teachers' Perception toward Mathematics Teaching Innovation in Indonesian junior high school: An exploratory factor analysis". *Journal of Mathematics Education*, 5(1), 97-120.

Sidhu, K. S. (1995), "The Teaching of Mathematics". New Delhi: Sterling Publishers Pvt. Ltd.

Rachna, P. (2012), "Innovations in Teaching of Mathematics". Waymade College of Education, Vallabh Vidyanagar. Retrieved from [www.waymadedu.org/StudentSupport/Rachnamadam.pdf](http://waymadedu.org/StudentSupport/Rachnamadam.pdf)

Vallerand R. J., Pelletier, L. G., & Koestner, R. (2008), "Reflections on self-determination Theory". *Canadian Psychology*, 49(3), 257-262.

Walker, E.N. (2007), "Rethinking Professional Development for Elementary Mathematics Teachers". *Teacher Education Quarterly*, 113-134.