2013

MATHEMATICAL ASSOCIATION OF NIGERIA

Happy 50th Anniversary

MATHEMATICAL ASSOCIATION OF NIGERIA (M.A.N.)

Proceedings

of

September 2013

Annual National *Conference*

Edited by:
PROFESSOR J.S. SADIKU

TABLE OF CONTENTS

EXPLORING MATHEMATICS AS TOOL AND NOT WEAPON OF DESTRUCTION THROUGH CONTENT AND PEDAGOGY AMONG STUDENTS: BASES OF ENTREPRENEURIAL DEVELOPMENT

OLAOYE, A. A.
Department of Science & Technology Education, Faculty of Education
Lagos State University, Ojo, Lagos State, Nigeria

ABSTRACT

Mathematics as a tool and not weapon of instruction implies making the learners see mathematical knowledge as a useful tool needed beyond the classroom boundaries. It means that learners must be equipped with the basic tools of mathematics in order to fit in and be relevant in the real world simply by applying the mathematics they learnt to the realities of life and not as a weapon of destruction. The essence of teaching and learning mathematics is to serve as a tool needed to promote responsible citizens and not terrorists. Therefore, mathematics teachers must strive hard to relate mathematical concepts as a tool to battle real life situations and ensure entrepreneurial development..

INTRODUCTION

Political issues deal with government, economics, and relationships among nations and social classes, which include people's welfare, preservation of natural and cultural resources. Mathematics is deeply involved with these issues and this is why mathematicians and mathematics educators cannot ignore them. The possibility of the final extinction of civilization on earth is real, and not only through nuclear war, which was a major threat during the Cold War, and which, in 1955, prompted two eminent mathematicians, Albert Einstein and Bertrand Russell, to invite other Nobel laureates to subscribe to a moving document, later known as *The Russell-Einstein Manifesto*, and thereafter transformed to the Pugwash Conferences on Science and World Affairs (Pugwash, 2002). The entire world is witnessing an environmental crisis, disruption of the economic system, institutional erosion, mounting social crises in just about every sect and, above all, the recurring threat of war. Sequel to the attacks of World trade centre in the United State of America on September 11, 2001, the uncertainties had become real threat to mental and emotional in equilibrium. Everyone was anxious about the next minute which makes one looks with fear and suspicion at ones neighbours, and this signal a similar scenario of the disruption of the Roman Empire seems to be at close range, with the aggravation that the means of disruption are, nowadays, practically impossible to control. Survival of mankind, with dignity for all, is a most urgent and universal problem. There is no doubt to say that mathematics is well integrated into the technological, industrial, military, economic, and political systems which see mathematics as unifying and integrating tool for their sustenance, and they have been relying on these systems for the material bases of its continuing progress. It is important to look into the role of mathematicians and mathematics educators in the evolution of mankind, particularly when mathematics is recognized as the most universal mode of thought. Thus it is appropriate to ask what is the most universal mode of thought that has to do with the

most universal problem along with survivals with dignity? This paper believes strongly that there is a need to find the relation between these two universals that are inescapable result of the claim of the universality of mathematics. Consequently, as mathematicians and mathematics educators, one needs to reflect about ones personal role in reversing the current world situation (D'Ambrosio 2001). This among others makes the present paper in reflecting about the role which is expected of mathematics educators in the contemporary society. This reminds one that there is an urgent need for mathematics educators to strive in ensuring that the knowledge of mathematics is not use as a weapon of destruction but as a tool to battle real life situations. Mathematics educators need to make the learners to see correlations between the useful knowledge of mathematics and the world outside the four walls of the classrooms.

To achieve this, recognizing a student's prior knowledge and life experience contributes to new learning in the classroom, and helps to build motivation and interest in order to ensure and achieve positive transfer of mathematical knowledge outside the classroom. The knowledge of mathematics should be used as a tool for prosperity and not otherwise, as corroborated by Osafehinti (2003) who postulated that the prosperity of any country depends on the volume and quality of mathematics offered in the school system. It is that tool with which man knows how many, how large, how fast, in what direction, with what chances etc. Hence, it is very useful in the formation of an educated man who Grittiths and Howson (2004) see as "The knowledgeable man trained to approach the affairs of his daily life with some sense of detachment and objective and to reason about them soberly and correctly. Similarly, Nna (2004) was of the opinion that mathematics is a pivoted subject to any art of useful living and societal development. He corroborated further by saying that mathematics is the art of counting, adding, subtracting, dividing and multiplying that are learnt with some fundamental mathematical process, and which of course has immense practical values in life as one carries out operations in buying, selling, coking, travelling etc. Applying mathematics as a tool not only help in making a complete man but also bring about a self reliant nation which cannot be over emphasized. This also explains why government, through the National Policy on Education (2001) mandated that it should be made compulsorily at both primary and secondary levels of education. It is therefore disheartening to observe that as important as mathematics is in the making of matured mind in every individual, the teaching and learning of the subject at all levels is still faced with enormous problems.

Studies conducted by Bayelo (2003), Egbugara (2004) revealed that mathematics is taught as a subject of mental depression for a number of school children. In the assertion of Igbokwe (2001) what is therefore required to improve that situation in schools are innovation in teaching and learning mathematics to provide a sense of satisfaction, a quickening of interest and thus the best kind of motivation stimulus to the students. It is also evident in literatures that most mathematics teachers tends to be more committed to the coverage of the subject matter content to the students' acquisition of mathematical knowledge which eventually helps the pupils to operate the content and apply it to real life situations (Bulter 2000) Egbugara and Ajewole (2002), Igboko (2003), Uhuche (2004) and Obioma (2005) recognized that a decisive factor is the way mathematics has traditionally been presented and experienced by students in the classroom. Students are

rarely given the opportunity to play with ideas in mathematics and not to talk of constructing their own for meaningful understanding. Rather, they are presented with mathematics through worked examples in the textbook, which in some cases make mathematics appear as a finished, pre-digested product.

Problems associated with the learning of mathematics: There are number of reasons why students seem to have difficulties in mathematics at different points of their developmental stages. One of these factors according to Julie (2011) cannot be dissociated from students' lack of conceptual for understanding. She postulated that the National Mathematics Advisory Panel (2008) recommended helping students master both concepts and skills and maintained that preparation for algebra requires simultaneous development of conceptual understanding and computational fluency, as well as cultivation of students' skill at solving problems. As an indicator of the level of emphasis placed on conceptual understanding, the final report of the National Mathematics Advisory Panel (2008) uses the words "concept" or "conceptual" 87 times in 120 pages; in comparison, the word "procedure" or "procedural" is used fewer than 40 times. This is why the National Council of Teachers of Mathematics (2000) stresses the importance of conceptual understanding for learning in mathematics and recommends an alignment of facts and procedures with concepts to improve students' learning. Thus, there is a consistent recommendation that teachers focus on concepts in mathematics, but in contrast what does it mean to focus on concepts, and how can this be done to develop students' conceptual understanding without sacrificing attention to required procedural skills? To accomplish this goal, teachers must first understand what conceptual and procedural knowledge are, and how these forms of knowledge differ from each other, or the relations among the two types of knowledge. This reminds one the domain of algebra, which discusses the definitions of conceptual and procedural knowledge, describing some of the particular conceptual difficulties which students tend to have and how these difficulties affect performance, on one hand and presenting empirically-based solutions to address the issues of conceptual understanding in real-world classroom settings.

Students lack deep understanding of concepts and procedures in mathematics: Conceptual knowledge has been defined as "an integrated and functional grasp of mathematical ideas" (National Research Council, 2001, p. 118). Consistent with this and other research on learning mathematics, conceptual knowledge is viewed as recognizing and understanding the important principles or features of a domain as well as interrelations or connections between different pieces of knowledge in that domain (Hiebert & Wearne, 1996). In contrast, procedural knowledge is the ability to carry out a series of actions to solve a problem (Rittle-lohnson, Siegler, & Alibali, 2001). Procedural knowledge is operationally defined as how to do something, while conceptual knowledge refers to an understanding of what features in the task, which collectively allows one to understand why the procedure is appropriate for that task (Julie, 2011). Unfortunately, for many students, these misconceptions persist even after traditional classroom instruction on the relevant topic (Booth, Koedinger, & Siegler, 2007).

Possible difficulties that hinder positive transfer of mathematical knowledge: Students experience significant problems in learning mathematics and applying mathematical knowledge judiciously manifest their mathematics learning problems in a variety of ways. Research indicates that there are a number of reasons these students experience difficulty in learning mathematics (Mercer, Jordan, & Miller, 1996; Mercer, Lane, Jordan, Allsopp, & Eisele, 1996; Mercer & Mercer, 1998; Miller & Mercer, 1997.) The following list includes these research-based mathematics disability characteristics of Students with learning problems.

Learned Helplessness - Students who experience continuous failure in mathematics might not have intrinsic confidence to compel them seeking assistance from others to complete tasks such as worksheets that could facilitate the student "get through" the current set of problems or tasks which devoid re-teaching the concepts, only reinforces the student's belief that they cannot understand mathematics.

Passive Learners - Students who have learning problems often are not "active" learners. They do not actively make connections between what they already know and what they are presently learning. When presented with a problem-solving situation, they do not employ strategies or activate prior knowledge to solve the problem. Students that have learning problems often believe that successful counterpart are those that got the answers without thinking of successful students in mathematics are those employing strategies to solve problems.

Memory Problems - Memory deficits play a significant role in students' mathematics learning situation. Memory problems are most evident when students demonstrate difficulty in remembering basic addition, subtraction, multiplication, & division facts. Memory deficits play a significant role when students are solving multi-step problem-solving situations which require the use of particular problem solving strategies. A common misconception about the memory problems in students is an information storage problem, which has to do with how students get problems articulated stored properly. This belief probably arises because student who does a mathematical at a particular point in time find a similar task difficult to solve the next day when presented with the same or slightly modified task. Teachers need re-teach the skills and have the same experience repeated. In contrast to an information storage problem, these memory deficits are often results of an information retrieval problem. For these students, instruction should include teaching students strategies for accessing and retrieving the information they have stored.

Attention Problems - Mathematics requires a great deal of attention, particularly when multiple steps are involved in the problem solving process. During instruction, students who have attention problems often "miss" important pieces of information. Without these important pieces of information, students have difficulty in trying to implement the problem solving process they have just learnt. For example, when one learns long division, one may miss the "subtract" step in the "divide, multiply, subtract, bring down" long division process. Without subtracting in the proper place, one may unable to solve long division problems accurately. Additionally, one may unable to focus on the important features that make a mathematical concept distinct. For example, when

teaching geometric shapes, students may attend to features not relevant to identifying shapes, instead of counting the number of sides to distinguish triangles from rectangles, the student may focus on size or colour. Using visual, auditory, tactile (touch), and kinaesthetic (movement) cues to highlight the relevant features of a concept is helpful for the students.

Cognitive and Meta-cognitive thinking deficits – Meta-cognition has to do with students' ability to monitor their learning, evaluate if learning is in progress/achieved, employing strategies when needed, knowing whether a strategy is successful, and making changes when needed. These are essential skills for any problem solving situation. As result of problem solving nature in mathematics, students who are not meta-cognitively adept have great difficulty of being successful with mathematics. These students need to be explicitly taught how to be meta-cognitive learners through teachers who model the process, teach students problem solving strategies, and reinforce students' use of the strategies, by organize them to assimilate the strategies, which in turn helps students' meta-cognitive deficits become meta-cognitive learners.

Low level of academic achievement - Students who experience mathematics failure often lack basic mathematics skills because it takes students with mathematical disabilities longer time to process visual and auditory information than typical learners. They often never have enough time or opportunity to master the foundational concepts/skills that make learning higher level mathematics possible. Providing these students many opportunities in mathematics tasks ensures better opportunities in a variety of ways and essential if they master the mathematical concepts/skills that teacher teaches. Additionally, teachers need to plan a periodic review and practice of concepts/skills that students have previously mastered.

Mathematics Anxiety - These students often approach mathematics with trepidation because of misconception that mathematics is difficult, and regard it as 'Mathematics time' otherwise called an anxiety-ridden experience. The best cure for mathematics anxiety is success, and to provide success starts first with the teacher. By understanding why students are having the difficulties, teachers are less inclined to place "blame" on the students for their lack of mathematics success which makes students feel continually feel they are not capable. The attitude with which teachers approach these students is crucial first step in rectifying the mathematics problems they are having. Providing these students with non-threatening, risk-free opportunities to learn and practice mathematics skills is greatly encouraged. Celebrating both small and great advances is also important, as providing instruction that is effective help students learn mathematics, thereby helping them to experience the success they deserve.

Teachers as facilitators

In order for teachers to facilitate student learning, several things need to occur and the processes which teacher undertakes are as follows: assess the students; plan the learning; implement the plan; and evaluate the process (Jennifer, 2010). It is imperative to state categorically at this junction that it is very likely that those students who are not seeing mathematics as a tool are most likely those students who are encountering difficulties in

learning mathematics. Since it is very important to understand the learning characteristics of students who are encountering difficulties in learning mathematics not seeing mathematics as a tool, it is also important to understand how mathematics instruction and curriculum issues negatively affect these students (Mercer, Jordan, & Miller, 1996; Mercer, Lane, Jordan, Allsopp, & Eisele, 1996; Mercer & Mercer, 1998; Miller & Mercer, 1997). The following list includes these instruction and curriculum issues as well as how they affect the students described above.

Spiralling Curriculum - Within a spiralling curriculum, students are exposed to a number of important mathematics concepts the first year. The next year, students return to those concepts, expanding on the foundation established the year before, and this cycle continues with each successive year. While the purpose of this approach is logical and may be appropriate for students who are average to become achievers, the spiralling curriculum is a significant impediment for students who have mathematics learning problems. The primary problem for these students is the limited time that is devoted to each concept. Students who have mathematics learning problems are rarely mastered the concept or skill taught as "exposure" to foundational skills is not enough. Without an appropriate number of practice opportunities, these students partially acquire the skill and when the concept or skill is revisited in subsequent period, they at a great disadvantage because the foundation they are expected to have is incomplete. This gives them an impression that mathematics is tool of destruction. After several years, the students might not only master the basic skills, but they have also not been able to make the important connections between those basic skills and the higher level mathematics skills being taught through the elementary, middle, & secondary grades.

Teaching understanding in an algorithm driven instruction -Although the National Council on Teaching Mathematics (NCTM) strongly encourages teaching mathematical understanding and reasoning, the reality for students with mathematics learning problems is that they spend most of their mathematics time learning and practicing computation procedures. Because of their memory problems, attention problems, and meta-cognitive deficits, these students have difficult in accurately performing multi-step computations. Therefore, an instruction that emphasis a procedural accuracy rather than on conceptual understanding is better applied. The emphasis on algorithm proficiency supersedes emphasis on conceptual understanding, e.g process of multiplication. Students that are taught the procedure of multiplication through drill and practice often do not really understand what the process represents. For example, if one considers the relationship of the following two multiplication problems: 2 x 4 = 8 and ½ x ¼ = 1/8. Students may be asked why the answer in the first problem is greater than its multipliers but the answer to the second problem is less than each of its multipliers, then students might not be able to answer. The reason is not far fetched as they have never really understood that the multiplication sign really means "of" and that "2 x 4 = 8" means two groups of fours objects, while " ½ x ¼ = 1/8" means one-half of one-fourth. Teaching understanding of the mathematics processes as well as teaching the algorithms for computing solutions is critical for students with mathematics learning problems.

Teaching to mastery: As described under "Spiralling Curriculum," students with learning problems need many opportunities to respond to specific mathematics tasks in order to master them. Teaching to mastery requires that both the teacher and the student monitor the student's learning progress on a daily basis. Mastery is indicated only when the student is able to perform a mathematics task at 100% accuracy for at least three consecutive period. In a situation where student progress is assessed only by unit test portends very difficult yardstick to determine whether such student has really mastered the skills covered in that unit. Even if the student performs well on the unit test, teacher cannot be sure that such student has reached mastery because of the learning characteristics that are not common for these students could make it possible for student not to score well if given the same test next period. Mastery could be inferred when the student demonstrates consistent mastery performance over time and such continuous assessment is rare in mathematics classrooms where students are many relatively to other school subjects with considerable numbers. When the evaluation of students is in progress by unit tests and the students with learning problems do not perform well, the teacher is left with a dilemma of how teacher take additional class time to re-teach the skill, thereby falling behind the mandated curriculum's instructional pace. Conversely, the teacher moves on to new material, knowing fully that students have not mastered the preceding skills, but making it less likely the students would have had prerequisite skills to learn the new information. This no-win situation could be avoided if continuous daily assessment is implemented for such students. It is easier and more time efficient to re-teach an individual mathematics skill the same day of initial instruction, or on the following day, than attempting to re-teach multiple mathematics skills many days after initial instruction is much more difficult and time consuming. Due to the hierarchical nature of mathematics, and where students do not master prerequisite skills, it is likely that they might not master the future skills.

Reforms that are cyclical in nature - The cyclical nature of mathematics curriculum or instruction reforms creates changing instructional practices that confuse students with learning problems. Like reforms for reading instruction, mathematics instruction swings from primarily skills-based emphasis to primarily meaning-based emphasis which depends on the philosophical and political trends of the day. While students who are above average achievers are able to manage these changes in instruction, students who have learning problems might not adjust well to such change.

Mathematics as a tool for prosperity and not weapon of destruction

The usefulness of mathematics to everyday life cannot be overstressed since it is general consensus among educators that mathematics is an important and useful subject for development of any country and in the understanding of other school subjects. No wonder mathematics has also been described by Bulter et al (2000) as 'The Queen of all sciences' while Ogunsulure (2004) considered "Mathematics as a handy tool in science. Latter might probably be an understatement as it would be much more tosay that mathematics is the basic instrument of science and the very essence of its theories. A strong background in mathematics is crucial for many career and job opportunity in today's increasingly and technology society. Adeyemo (2003) opines that in modern time issues like industrialization, the development of automation system engineering,

technology, environmental design, efficient transportation and communication system architecture, construction of bridges, computer development and a host of others depend undoubtedly on a sound knowledge of mathematics. The importance of modern science and technology in the society also makes it a compelling device that a developing country like Nigeria should give priority attention to the utilitarian qualities derivable from practical problem solving and intensive teaching. Afolabi (2002) in her study of difficulties encountered by SS .II student in interpreting word problems in three dimensional geometry and its concept serve as a bridge linking mathematics with the real world. The fact that mathematics plays vital role in the understanding of sciences is not debatable. It is an intellectually stimulating discipline such that taking mathematics out of the sciences is like taking life out of human being with body becomes functionless. Mathematics is the hubs around which all the science and environment professions are built. House wives and market woman use mathematics from time to time. The military find it useful in their warfare. So it is indispensable in all facets of life as it is a useful tool in the hands of engineers and mathematicians. According to Adeyemo (2003), the Egyptians, Greek and Roman arcades were all wonderfully constructed based on a sound knowledge of mathematics. Mathematics equally offers us a medium for expressing complex relationship and provides conceptual framework for organizing information in politics' today nation supremacy in warfare and is indisputable determined by her "excellence" in the knowledge and use of mathematics (Fakuade 2005). Mathematics plays a vital role in disciplines like Biology, physics, chemistry, architecture, banking, medicine and all other subjects (Odumosu and Olaleye, 2005).

Critical overview and suggestions

Students often fail to make the connection between "school mathematics" and their everyday lives, because of passive recipients of an isolated, memorized rules and formulas. This paper assists teachers to help students become active problem-solvers and see mathematics as a meaningful tool that could be used outside the classroom. This is achieved by increasing the students' awareness of meaningful everyday applications of the knowledge acquired during the period of learning, students use mathematics as an essential tool in their daily lives and not as weapon of destruction. And finally, teachers need to know that no one expects them to have all the answers just because they are certified ones but they should engage in multiple times before experiencing success as a part of learning, which ensures adequate entrepreneurial development.

REFERENCES

Ajewole, G.A (2007) Science Technology and Mathematics Education and Bio-Diversity Conservation for Sustainable Development in Africa. 50th Annual Conference Proceeding of STAN, 113-117

Bayelo (1987) Principles and practice of mathematics: In secondary school Ibadan: International Publishers Ltd.

Booth, L, Koedinger, K. R., & Siegler, R. S. (2007, August). The effect of prior conceptual knowledge on procedural performance and learning in algebra. Poster presented at the 29lh annual meeting of the Cognitive Science Society in Nashville. TN.

Booth, . I... Paré-Blagoev, E. , & Koedinger. K. R. (2010, May). Transforming equation-solving assignments to improve algebra learning: collaboration with Ihe SERP-MSAN partnership. Paper presented at the annual meeting of the American Education Research Association, Denver. CO.

Bulter C. 2003: Journal Fraction instruction for students with mathematics disabilities; comparing two teaching sequences: Learning disabilities research and practice 18 (2003): 99-111.

D'Ambrosio, Ubiratan. 2001. "Mathematics and Peace: A Reflection on the Basis of Western Civilization." *Leonardo*, 34(4): 327–32.

Egbugbara, U. O. (1988): Sustaining Students' Interest in Science through Games. The Vocabulary disc and optiminoes. *Science Teachers' Association of Nigeria (STAN) Annual Conference Proceedings* (pp 98-101). Ibadan: Heinemann Educational Book (Nigeria) Plc.

Fakuade R.A. (1992): Teaching Arithmetic and Mathematics in the Primary School. Ibadan University Press

Griffith, J. (1999): An Investigation of Coping Strategies Association with Job Stress in Teachers. *British Journal of Educational Psychology* pp 517-531.

Hiebert, J., & Wearne, D. (1996). Instruction, understanding, and skill in multidigit addition and subtraction. *Cognition and Instruction*. 14, 251 -283.

Hiebert, J. & Wearne, D. (1993): Instructional Tasks, Classroom Discourse, Students' Learning in second-grade Arithmetic. *American Educational Research Journal*, 30(2), 393-425.

Igbokwe, D. I. (1977) Innovations in Mathematics using practical skills. STAN conference proceedings.

Igbokwe, N.K. (1991): Planning and educational development in Nigeria. Journal of research in science teaching Vol. 24 No 3 (Pp 24 – 30).

Julie L. Booth, Ph.D., is an Assistant Professor in the department of Psychological Studies in Education at Temple University.

National Council of Teachers of Mathematics (NCTM) (2000). Pdnciphs and standards for school mathematics. Reston, VA: Author.

National Mathematics Advisory Panel i2008). Foundations for success: The final report of the National Mathematics Advisory Panel, v.s. Department of Education: Washington, DC.

National Research Council (2001). Aclding it up: Helping children learn mathematics. I. Kilpatrick, O. Swafford, & B. Findell (Eds.). Washington DC: National Academy Press.

Nna E.C (2004) Promoting Effective Teaching and Learning of Mathematics on the primary school.

Obioma, G (2005): Restructuring the Primary and JSS curriculum in Daily Trust (Nigeria) 20th September 2005 p. 6

Obioma, G. (2009). Mathematics Education curriculum Development in Nigeria. A Historical analysis" Daily independent (May 11, 2009) Lagos.

Odumosu, K. (2005) Essential statistics Jen Ace Publishers Lagos

Ogunsulure, D. K. (2004) Mathematics as a discipline: Its usefulness in Relation to Life. *Abacus Journal of the Mathematical Association of Nigeria 30(1)*

Osafehinti I.O (2003) The University of Mathematics. ABACUS, Journal of Grittish and Howson (2004). Pugwash Conferences on Science and World Affairs. 2002. Retrieved January 25, 2002, at http://www.pugwash.org/.