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TEACHING MATHEMATICS FOR CREATIVITY IN NIGERIA: CHALLENGES AND PROSPECTS

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Abstract: *This paper discusses the need for teaching mathematics for creativity in Nigeria, the need stems from the significant role mathematics plays for the development of science and technology which are in turn indices for national development. The paper addressed the concept of mathematical creativity which is principally to create something new or unusual and the ability to see new relationships between techniques and areas of application as well as making associations between unrelated ideas. This was followed by pointing out the indicators of mathematical creativity as attitudes, abilities and methods of preparation and manipulation of information. The condition under which mathematical creativity can occur were raised such as conducive environment, creative thinking, among others. Also raised was the state of teaching mathematics in Nigeria which is characterized by conventional method of teaching and does not provide for mathematical creativity. However, mathematical creativity in the Nigerian classrooms is to produce citizens with excellent mathematical knowledge to compete favourably in the world economy. The paper equally highlighted the challenges to include overcrowded classrooms which do not augur well for autonomous learning essential for development of mathematical creativity. However, these challenges can be overcome by creating, conducive learning environment aided by teaching technologies to mention but a few. The paper concludes by stressing the fact that creativity is what makes the difference between developed and developing nations. Hence if Nigeria must develop scientifically, socially, economically and technologically her citizens must acquire mathematical creativity.*

Keywords: Teaching Mathematics for Creativity; Nigeria; Challenges; Prospects.

Introduction

Mathematics has been widely recognized and accepted as a driving force for scientific, economic and technical development (Anyor, 2012). This development may require creative talents for it to occur. Thus for the needed development to occur the citizens of any nation must be creative, Mann (2005) therefore proposed creativity as one of the major components to be included in the education of the 21st century. Thus, in line with the world's desire to foster creativity in the education system, the Federal Government of Nigeria's policy on education (FGN, 2004) emphasizes the production of creative and creative thinking citizens, in general and particularly, in mathematics. According to Craft (2003) and Gibson (2005) the two main driving forces for the growing demand and value placed on

creativity are students' personal fulfillment and their economic capabilities as future citizens. In particular, Mathematics education may be regarded as the key to scientific, economic and technological development of all nations. For example in America, the Committee on Science, Engineering and Public Policy in 2005 developed a list of recommendations needed to ensure that united state can continue to compete globally includes an increase in America's talent pool by vastly improving K-12 Mathematics and science education. Nigeria has followed suit and seeks to develop and improve creativity at all levels of education. This paper examines the concept of Mathematic creativity, indicators of mathematical creativity, Developing Mathematical, Benefits of mathematical creativity, conditions for mathematical creativity to prevail, challenges and prospects. It is hoped that this write up will throw more light on the need for creativity and create desirable mindsets for fostering creativity in schools.

The Concept of Mathematical Creativity

The concept of mathematical creativity has been described variously as there are mathematicians. Treffinger, Young, Selby and Shepardson (2002) acknowledged that there are numerous way to express creativity and identified over 100 definitions. For example Runco (1993) describes mathematical creativity as a multi-dimensional construct involving both divergent and convergent thinking, problem formulation or finding and solving, self-expression, intrinsic motivation, a questioning attitude and self-confidence. Also Haylock (1997) saw mathematical creativity to include the ability to see new relationships between techniques and areas of application and to make associations between unrelated ideas. Krutetskii (1976) characterized mathematical creativity as problem formulation, invention, independence and originality. From the above definitions it is observed that creativity involves critical thinking outcomes of man's interaction with the real world environment characterized by novelty and appropriateness. According to Bear and Kaufman (2006) novelty is synonymous with originality, newness, difference, uniqueness or unusualness. On the other hand they consider appropriateness as effectiveness practicability or usefulness. Relevant to Bear and Kaufman's consideration is Singh's (1988) definition of mathematical creativity as a process of formulating hypotheses involving cause and effect in a mathematical situation, testing and re-testing these hypotheses, modifying them and communicating the results. Singh's definition directs to the need to be creative in using mathematics in the solution of real world problems which is the essence of mathematics. The question now is how do we measure creativity?

The above question was answered by Balka (1974). Balka introduced the criteria for measuring mathematical creativity ability. He emphasized both convergent and divergent thinking. Balka (1974) addressed convergent thinking as characterized by determining patterns and breaking from established mindsets or fixation and divergent thinking was defined as formulating mathematical hypotheses, evaluating unusual mathematical ideas,

sensing what is missing from a problem and splitting general problems into specific related sub problems. Balka's insistence on breaking the established mindset gives a clear picture of mathematical creativity. Haylock (1997) believed that overcoming fixations was necessary for creativity to emerge. Sign's (1988) measures of fluency, flexibility and originality have so far been widely adopted or adapted in developing mathematical creativity, these measures are however limited to research works and not in the classrooms situation for teachers use. This leads us to the indicators of mathematical creativity in the classrooms.

Indicators of Mathematical Creativity

The indicators characterizing promising young students' mathematical creativity is their ability, motivation, self-efficacy and opportunity or experience (The National Council of Teachers of Mathematics, MCTM, 2000). Davis (1969) however, considered three parameters as attitudes, abilities and methods of preparation and manipulation of information as key indicators. The above attribute to creative individuals are imperative and requires teachers teaching creatively for these indicators to emerge.

Condition for Teaching for Creativity

Teaching for creativity and creative learning requires conducive environment for creative thinking, critical and divergent thinking to occur. Hennessey and Amabile (2010) identified factors that are crucial for any organization seeking to nurture creative endeavor and output. These factors include psychological safety, recognition of the value of intrinsic motivation sufficient time, autonomy, feedback and creativity goals. Horng, Hong, Chanlin, Chan and Chu (2005) suggested that the classroom environment has to be student centered learning, management, connections between teaching content and real life situations and presenting open mathematical questions. Niu and Lui (2009) found that simple encouraging words as "be creative" resulted in more creative outputs from students.

All these conditions are relevant in the Nigerian education system as it is elsewhere, In Nigeria our schools are adversely affected by continuous levels of stress and feelings of insecurity, among others, occasioned by teacher-strikes for non-payment of salaries, political crises, cult activities, communal crises, activities of BOKO Haram and the like. These often lead to closure of schools. Teachers and students need an environment that develops creative thinking and be creative. Time is needed uninterrupted for learners to sleep on problems requiring mathematical solutions. There is need to develop intrinsic motivation in students for positive attitudes, relentless tackling of problems, providing feedback and appreciate and pursue creativity goals. What is the state of teaching for creativity in Nigeria? This question is answered in the following section.

The State of Mathematics Teaching in Nigeria

In Nigeria research literature is replete with the prevalence of conventional methods of teaching (Anyor, 2012). The conventional methods for solving mathematical problems follow specified rules and procedures for problem types. Hence students learn mostly by rote. Very often some students score very high marks in the senior secondary certificate examinations conducted by the West African Examination Council (WAEC) and Nation Examination Council (NECO) and are rated as intelligent, gifted and talented in mathematics. However, Hong and Aqui (2004) found that a high level of achievement in school mathematics is not a measure of high level accomplishment in mathematics. This seemingly detachment between mathematics achievement and accomplishment in school mathematics indicates that some talented students are overlooked in the current practices (Mann, 2006). Kim, Cho, and Ahn (2003) found that traditional tests to identify the mathematically gifted such as commercial available achievement tests or state assessments do not identify or measure creativity but essentially reward accuracy and speed. Hong and Aqui (2003) found significant differences in cognitive strategies used by two groups, (High and low achieving students) and creatively talented. They found that the creatively talented were more cognitively resourceful. They suggested that neither group should be neglected. The above discussion poses a great challenge for both mathematics educators and the society. Nigeria is not free from this challenge to derive the benefits of teaching mathematics for creativity driven economy and development.

Benefits of Mathematical Creativity

The existence of large theories and research works on creativity in general and mathematical creativity in particular is recognized as one of the educational goals (Choe, 2006; Niu, 2006). This indicates that individuals and nations including Nigeria may derive some benefits from teaching for creativity if properly planned and executed in our mathematics classrooms, such benefits are likely to include:

1. Acquisition of excellent mathematical knowledge by Nigerian citizens. This may enable the individuals to make connections between several concepts and types of information (Sheffield, 2009), this may ensure the application of mathematics in productive sectors of the economy.
2. It may also help students to be proficient in learning mathematics and compete more favorably in the knowledge world economy.
3. Research reveals that students who imagined carrying out mathematical tasks instructions out performed those who simply memorized the instruction (Leahy and Smeller, 2008). This implies that creativity is conducive to learning and leads to academic success.
4. Creativity generates interest, motivation and self-efficacy in students, hence their positive attitude to the study of mathematics. This may lead to attainment of national goals of mathematics education.

5. Teachers who teach creatively and for creativity may derive self satisfaction and promote creative activities in schools for national development.

Challenges

Despite the benefits that are likely be derived from teaching mathematics for creativity the following challenges could close the gate to its success. These challenges include;

1. The mathematics classrooms are dominated by ill-trained and ill-equipped teachers to teach creatively and for creativity
2. Our school system is time bound in terms of lesson periods, term or semester and so on. This does not augur well to teaching for creativity which requires enough times, how enough may not be easily defined.
3. Although creativity is regarded as an indicator of high and appropriate achievement, the teacher's view of creativity may decide how successful or not creative activities are successful.
4. One of the components of teaching for creativity is autonomous learning and teacher's attention to individual activities. This may not be possible due to over-large classes in our schools.
5. Other constraints may include teachers' excessive work load, lack of up-to-date appropriate text books, overcrowded classes and lack of suitable accommodation.
6. In an education system where paper qualification is emphasized students work towards taking examinations which demand the use of rules, procedures and rule based algorithms becomes a constraint. The students may consider teaching for creativity a waste of time. This could erode their interest, and attitude towards learning creatively.
7. The need for developing uniform assessment standards for creativity in all school poses a great challenge. There does not exist now a standard measurement instruments (Hennessey and Amabile, 2012)

Prospects:

The challenge outline above does not imply that teaching for creativity in Nigerian's school system cannot work at any point in time. The following may render effective possibility that can erode the challenges for teaching for creativity to prevail. These include:

1. Developing and encouraging intrinsic motivation in our students is likely to set aside the effect of momentary, religious Boko Haram, communal and Fulani crises in Nigeria.
2. The learning environment has a lot of local materials for mathematical project for teaching for creativity. Projects may include construction of shapes, modification of mathematical concepts and procedure or inventing more appropriate symbols for specific situational equations.
3. Developments in technology take interesting position in education. The emergences of computers, graphing calculators, are good examples. Computers permit for the

power of simulation which can be used for creative teaching and learning. However, Rinkerich (2011) argues that the programmed nature of computer soft wares does not allow for flexibility and originality for creativity to prevail. She likened computer to rule-based algorithms as mathematics based solution procedures. It is however, recognized that computer have a great potential for creative teaching and learning (Coitti, 2011).

4. Teaching for creativity can be made possible by adopting multi-disciplinary lessons in mathematics classrooms. In this way, concepts and connections between seemingly unrelated areas make new concepts emerge (Ciotti, 2011).
5. The possibility of the engagement of students in mathematics creative activities in mathematics classrooms serve as a positive step in this direction teaching for creativity.
6. Mathematics teaching and learning is for application for the solution of real world problems in all human work and study. The most appropriate is mathematics modeling which lends itself to applications.

Conclusion

Creativity has been with us from time unknown, however, some people of a given race and/or culture could be more creative than others. This is likely the reason why we talk of the developed and the developing countries of the world. Thus for Nigeria to develop scientifically, socially, economically and technologically her citizens must be creative especially in mathematics classrooms. Mathematics is widely accepted as the language and tool for national development. The challenges pointed out should serve as indices for corrective measure for teaching for creativity in our schools.

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