

METHODS TO BUILD, DEVELOP MATHEMATICAL CONCEPTS AND SKILLS IN THE EARLY CHILDHOOD MATHEMATICS IN NIGERIA

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Abstract: *Effective teaching and learning of early childhood mathematics are of great importance to every country's educational system, most especially in Nigeria. Early childhood mathematics is the first contact of young children with mathematics in the formal school setting. Therefore, this early stage must be well taken care of to foster and build a proper solid foundation in their mathematics education and other subjects. This stage of life is where mathematics concepts and skills can be developed in them for future use and success in school. Mathematics assist young children to think and make sense of the world around them. The paper looked at Nigeria education policy briefly, some of the ways effective teaching and learning of early childhood mathematics can be achieved and developing mathematical counting skills in early childhood mathematics. Some methods of teaching mathematics at the early childhood were also discussed.*

Key words: *Methods; Mathematical concepts; skills; Early childhood; Mathematics*

Introduction

The recent and proliferation of early childhood education programme throughout the country, Nigeria, calls for an urgent attention to intensify effort to maintain quality early childhood education. There is need for professionally qualified mathematics teachers and effective teaching methodology on how to handle or teach these beginners of mathematics. Many practicing day care providers/owners and teachers we have today do

not have the necessary training or requirements needed to promote early childhood mathematics education. Various types of knowledge, expertise and skills are very crucial in assisting the young children learn mathematics. The teachers need to acquire expertise in the areas of how to teach early childhood mathematics. The mathematics teachers need to ascertain the knowledge these children have already acquired in mathematics, the way they think, reason about it, and how they learn it. Research has shown that young children have surprising interest and competence in early childhood mathematics (Ginsburg & Baron, 1993). The teachers need to appreciate the knowledge these children have already gained in mathematics that they are to learn. Early childhood mathematics deals with mathematical ideas such as cardinal numbers and patterns, there is the need for teachers to understand them (Ma, 1990). Teachers needs to understand, develop and use effective strategies for teaching the young children mathematics (Lampart, 2001). Early childhood mathematics is very important for young children's present and future success in school. Research has shown that all young children have the ability to learn mathematics and become competent in it (National Research Council. (2009). At this early stage of life, the children are eager and interested to learn mathematics, but much attention are not being paid to teaching them before entering the formal school settings for learning.

Nigeria Education Policy

Primary education is the foundation and major component of the universal basic education (UBE) programme in Nigeria. The main objectives of the Nigeria education system as stated in the National Policy on Education being; access and to ensure quality in the delivery of basic education. Some other objectives are: i) “to inculcate in the children permanent literacy, numeracy and the ability to communicate effectively (FRN, 2013)”. ii) “Lay a sound basis for scientific, critical and effective thinking. Provide opportunities for the child to develop life manipulative skills that will enable the child function effectively in the society within the limits of the child’s capacity (FRN, 2013).” In order to achieve these stated objectives, the federal government included mathematics in the National policy on Education and therefore made it as a compulsory subject throughout all levels of educational system. To inculcate in the children permanent literacy and numeracy and laying sound basis for scientific and reflective thinking call for the study and the use of mathematics.

There are different levels of classroom competence the teachers must possess in order for his/her teaching of the early childhood mathematics in the school to be effective (Onoshakpokaiye, 2010). The purpose of teaching mathematics to the children in school is enable them develop and acquire mathematics skills that will assist them to succeed in their future education,

become useful to themselves and contribute to the progress of the society which they lived. Hence there is the need for the mathematics teachers to use effective and appropriate methods or strategies that can arouse the young children interest towards studying or learning mathematics at all levels of education, most especially the young children. By so doing, early childhood mathematics will be actualized and the ultimate stated objectives of the national policy on education will also be achieved

Early childhood mathematics education

Mathematics is an indisputable queen of all sciences and one of the core subject students offered in schools both at the primary level up to the tertiary institutions of learning due to its important nature to human learning and everyday activities. Mathematics education for early childhood is a basic foundation for the future learning of mathematics. The beginning of child learning of mathematics is of great importance. The early years of young children life requires them to explore or discover mathematics concepts and ideas of the world around them. It enables the young children to reason, think critically and make sense out of the world inside and outside the school which eventually help them in building solid foundation for their success in school.

The early stage of the children in mathematics requires them to understand the concepts, ideas and manipulative skills needed to understand the subject “mathematics” before attaining adulthood. At their early stage of life young children require mathematical understanding of the concepts and skills needed to succeed in their education in all careers and even everyday life. Mathematical proficiency or competency is needed from the young children for them to succeed in their course work that provides a gateway to technological literacy and higher education (Haycock & Huang, 2001, Haycock, 2001, Schoenfeld, 2002, The Education Trust, 2001). Apart from ensuring a basic and sound mathematics foundation for all members of the society, there is the need to equip the increasing numbers of young people for work which require a higher proficiency level (Kilpatrick, Swafford & Findell, 2001, U.S department of labour bureau of labour statistics, 2000, NAEYC & NCTM, 2010). According to National Association for the Education of Young Children (NAEYC) and The National Council of Teachers of Mathematics (NCTM) (2010), with reference to Americans observed that “if progress in improving mathematics proficiency of Americans is to continue, much greater attention must be given to early childhood mathematics experience”. This statement is also applicable to Nigerians, no progress can be made without the success or improvement of the early childhood mathematics. For a nation to improve or progress in mathematics, early childhood mathematics must be given priority, since it is

the foundation upon which every other levels of education are built, otherwise that nation will be backward mathematically (Onoshakpokaiye,2007).

The future of the young children in learning and understanding mathematics require them building a solid foundation at the early stage based on high-quality of teaching, professional teachers and accessible to good mathematics education, exerting much effort, time and commitment by the mathematics teachers to teach the early childhood mathematics and which will eventually contribute to significant progress of young children mathematics learning. The young children need to be allowed to experience mathematics in every setting through effective research- based curricular and teaching practices. In carry out these practices, the teachers are required to have good support of the education policies, good educational facilities and resources to enable them succeed in this challenging task and important work of teaching the young children (NAEYC & NCTM, 2010)

SOME OF THE WAYS EFFECTIVE TEACHING AND LEARNING OF EARLY CHILDHOOD MATHEMATICS CAN BE ACHIEVED

Recognize and Build on the young children’s knowledge and experience

Noting that the young children came from different home background, social economic status, and cultural background and having different experiences, there is the need for the teachers to recognize these individual differences so as to accommodate and have effective early childhood mathematics teaching /learning. Building and recognizing children individual experiences and knowledge are central to the teaching/learning process (NAEYC & NCTM, 2010). Since these children are from different cultural, linguistic, home background and having different experiences from their community, there is need for the mathematics teachers to recognize their individual differences. It is of immense importance for the teachers to know much about such differences among them and put much effort so that he/she can build bridges between these individual different experiences and new learning so as to achieve equity and educational effectiveness (Berk & Winsler, 1995, Heath, 1983, Vygotsky, 1934)1986).

Recognizing the young children individual strengths, learning styles will help in making mathematics curriculum and instruction to be more effective. Since the young children first mathematics knowledge they acquired is through intuition, the mathematic concepts need to be well explained to enable the children make maximum use of their prior knowledge and therefore connect it to school mathematics. The young children are happy and enjoy their early informal experiences with

mathematics. Therefore, improving the early childhood mathematics education can provide basic foundation for the young children success in school. Building on the young children mathematical experiences acquired through play and the relationship between their learning and their everyday life help in teaching and sustain the interest of the young children in mathematics. When young children have a pre- knowledge of a particular mathematics concepts or ideas, the work become easier for the teacher to carry out. Since they already have entry behavior and it make easier for them to understand. When the previous experiences or knowledge of the young children are connected to their new experiences or knowledge, they therefore gain confidence, competence and are interested in mathematics (NCTM, 2000, Bredekamp & Rosegrant, 1995). Hence teachers need to ascertain the young children previous knowledge or experiences and therefore build on it so as to enable them understand and succeed in learning mathematics.

In early childhood mathematics, there are many experiences require from the young children to enable them relate their knowledge to mathematics language and concepts which they have acquired through intuition at the early childhood mathematics. When these concepts they have acquired through intuitive are effectively taught, it assists them to make full use of their prior knowledge and eventually connect it to the school mathematics. Effective early childhood mathematics programmed provide many opportunities for young children to represent, reorganize, generalize, quantify, and refine what they have gained through experiential or intuitive level (Clements & Conference Working group, 2004).

Curricular offered should match their mental development

For effective teaching of the early childhood mathematics to take place in the schools, the mathematics curriculum offered to the young children must be well structured according to their mental development to sustain their interest. What the teachers will teach, how to teach it and who to teach it, is of great importance in the teaching of the young children for the teaching /learning to be effective. Nwachukwu (2009), stated that “knowledge has various levels of objectives which can be grasped by the child whose mental development is keeping with the levels of knowledge given to them.” He stated further by saying that teachers should take the entry behavior of the young children into consideration since it is the basic foundation in which new knowledge is built. According to Onoshakpokaiye (2007), young children have different ways of understanding particular mathematics concepts therefore teachers should endeavour to intensify effort to carry them along. The author stated further that young children’s individual strengths, learning styles makes mathematics curriculum to be more effective at the early childhood. For teaching / learning of mathematics

to be effective, mental development of the child must match the activities to be carried out otherwise teaching will be ineffective (Onoshakpokaiye, 2010).

Encourage young children natural interest and good learning environment

Young children at their early year of life usually show a natural interest and also enjoy mathematics since it is their first formal contact with mathematics. National Research Council (2009) stated that “mathematics learning has often been more a matter of memorizing than of understanding. Today it is vital that young people understand the mathematics they are learning. They are positively disposed to do and to understand mathematics when they first encounter it.” Research has showed that young children spontaneously explore and use mathematics before entering school, this usually come through intuition and during this stage their mathematical knowledge can be quite complex and sophisticated (Seo& Ginsburg, 2004). The young children play and interests are the foundation of their first mathematical experiences, which provide basis for their future mathematics learning in school (Seo& Ginsburg, 2004; Van Oers, 2010). NAEYC & NCTM (2010), stated that during the young children play and activities they usually explore mathematics ideas and processes, here they make comparison of quantities, classify, sort and observe shapes and patterns, in this process they acquire mathematical concepts, ideas and skills useful for learning mathematics. NAEYC & NCTM (2010), went further to state that “mathematics helps children to make sense of the physical and social worlds around them, and those children are naturally inclined to use mathematics.” When teachers capitalize on such moments and carefully plan variety of experiences with mathematics ideas in the mind of children, mathematics sense and interest can be cultivated and serves as basis for further learning.

It is of great importance for young children to develop confidence in their ability to understand and use mathematics. Let them see mathematics as within their reach. NCTM (2000), stated that since experiences of the young children shape their attitude towards mathematics, it is important to engage and encourage good learning environment for their early encounter with mathematics to enable them develop confidence in their ability to understand mathematics and also to make use of mathematics. According to Clements & Conference Working Group (2004), young children develop disposition, they are curious, imaginative, inventive, and flexible and persistence when their experiences are positive in the process of using mathematics to solve problems and this eventually contribute to their future success in early mathematics in and out of school.

Mathematics curriculum and teaching practices should be based on the knowledge of young children developmental stages

Early childhood mathematics curricula and teaching practices should be based on solid understanding of both mathematics and the development of the young children. This should be well monitored through observation and other informal evaluations to ensure that instructional decisions are based on each child mathematics needs. The curriculum should be well structured so that the young children will able to cope, comprehend and cover it. The environment and the background of the young children should also be well reflected in the curriculum. Knowledge of the young children developmental stages is very crucial as regard to teaching and learning of mathematics. First and foremost, teachers must be equipped or have a broader knowledge of young children cognitive development, their reasoning ability, concepts development and then how these concepts can be acquired.

Every decision as regard to mathematics curriculum and teaching practices should be based on the knowledge of the young children development and learning such as their cognitive, linguistic, physical and social-emotional. For the effectiveness of mathematics teaching, there is the need for the mathematics teachers to have broader knowledge of cognitive development of the young children and also be familiar with their social-emotional and motor development, all of these are relevant to mathematics develop (NAEYC & NCTM,2010). To determine the types of questions or puzzles and manipulative materials that will be needed to complement learning of mathematics, the teachers need to combine the knowledge of early childhood cognition with the knowledge of their motor development (Bronson, 1995).

Make provision for enough time, materials and engage the children in play to help them explore and use mathematics ideas

According to NAEYC & NCTM (2010) “children become intensely engaged in play. Pursing their own purposes, they tend to tackle problems that are challenging enough to be engrossing yet not totally beyond their capacity.” Agwagah (2005) stated that to develop critical thinking in young children, mathematics thinking should be based in teaching mathematics. The interactions of the children during play provide them with the natural challenges that involve critical thinking. When young children have the same problems, they usually discover different approaches on how to handle it, then discuss it and learn from one another (Natasi& Clements, 1991, Yackel, Cobb & Wood1991). Play tend to prompt and promote critical thinking and learning in mathematics and other subjects.

Though play does not guarantee mathematical development, but it assists in the development of mathematical ideas. The important aspect of play is that it assists in learning and also enable the young children to develop critical thinking and promote learning of mathematics among them. For the teachers to achieve the purpose use of play in promoting mathematics learning at the early childhood, he/she need to follow up by reengaging the young children to recall and represent mathematical ideas acquired during play time. Mathematics learning is enhanced when the mathematics teachers asks the young children provoking questions that needs clarifications, extensions, and development of new understandings (NCTM, 2000). Play assist the children to acquire mathematics skills and experiences on how objects are related, these experiences serve as foundation for the development of mathematics concepts (NAEYC & NCTM, 2010). Classic unit blocks and other construction materials such as connecting blocks give children entry into a world where objects have predictable similarities and relationships (Leeb- Lundberg, 1996, Pratt, 1948, NAEYC & NCTM, 2010).

There should be provision of enough teaching materials and good numbers of periods in the early childhood mathematics programmed to enable the children learn mathematics through playful activities that encourage counting, measuring and constructing with blocks (NCTM, 2000, Hildebrandt & Zan, 2002). The teacher can observe and study the children during play, learn more about their development, interests and therefore use the knowledge to teach them and inform the curriculum planner and instruction.

Integrate mathematics with other activities

In teaching young children mathematics, the teachers need to integrate mathematics with other activities to make the lesson more meaningful and interesting to them. The children everyday activities and routines can be used to introduce and develop important concepts or ideas in mathematics to the children. Early childhood mathematics teachers can help the young children develop mathematical knowledge through other activities carry out by the children. The teachers can use every available opportunity to build and develop the young children understanding of mathematics. Early childhood mathematics teachers should actively introduce mathematics concepts, good methods and language through different appropriate experiences and effective teaching/learning strategies.

Every activity of the children can be used to teach them mathematics. Mathematics can be integrated into the young children experiences such as social studies, literature, music, language, science, art, movement and all parts of the classroom environment. An extended investigation gives the young children excellent opportunities to apply mathematics, as well as to

develop independence, persistence and flexibly in making sense of real-life problems (NCTM, 2000). NAEYC & NCTM (2010), stated that “teachers should ensure that the mathematics experiences woven throughout the curriculum, it should follow logical sequences, allow depth and focus, and help children move forward in knowledge and skills”. It further stated that the concepts should be developed in a coherent and purposeful manner.

Introduce mathematical concepts, good teaching methods and appropriate experiences.

Teachers’ efficient use of different approaches, strategies and materials to support the interest and ability of the children in mathematics is of great importance for an effective early childhood mathematics curriculum programme. Besides integrating significant mathematics learning in play, classroom routines, learning experiences across the curriculum are necessary. For effective early childhood mathematics programme, there is need to provide carefully planned experiences that focus attention on children development of mathematical concepts, ideas or set of related ideas. Teachers need to think of ways in engaging young children in revising previous concepts when planning for new investigations and activities, such experiences help the children to link the new concepts with the previously acquired mathematics ideas and concepts (NCTM, 2000).

Mathematics is an integral part of everyday life and so it should be connected to everyday activities (Onoshakpokaiye, 2007). The method of introducing and modifying games by the teachers can promote important mathematics concepts and provide opportunities for children to practice skills (Kamii& Housman1999, Griffin, Case &Capodilupo, 1995). For instance, teachers can modify any simple board game in which players move along a path to make the game more mathematically powerful and more appropriate for children of differing developmental levels (Kamii& Housman, 1999, Charlesworth, 2000, NAEYC & NCTM (2010). According to Fuson (2004) cited in NAEYC & NCTM (2010), effective early childhood teachers build on children informal mathematics knowledge and experiences, always taking children background and language into consideration.

Teacher education programmes should pay special attention to the mathematics curriculum of early childhood and develop themselves professionally to support high-quality mathematics education. They should be versatile in terms of mathematics content, pedagogy and knowledge of child development and family relationships. The development of institutional policies that promote teachers’ mathematical learning, teamwork and planning can provide necessary resources to overcome classroom, community, institutional and obstacle to young children proficiency in mathematics (NAEYC & NCTM, 2010).

Developing mathematical counting skills in early childhood mathematics

Pre-counting

Mathematics skills taught in early childhood education are designed to provide the basic foundation for children to succeed in elementary school and other educational levels. Number sense is the ability of the children to count accurately, first forward, then later in school, they will learn how to count backwards. Numeracy or number system is a very important skill needed by the early childhood mathematics to move ahead; it is the ability to count. It is the basic foundation for learning numbers and also the first mathematical skill that a child must develop. At the early childhood, children must learn how to count number either forwards or backwards and know the relationship between these numbers to equip them for future education.

The pre-counting is very vital in teaching the young children mathematics, it focuses on understanding the concepts and how they are related to one another. At this early stage of life, the young children develop these concepts by making comparison but no counting. These concepts are of great importance to the children learning of mathematics, it laid the solid foundation for the child development in mathematics and also assist the children in understanding the difference between these numbers and the different ways these numbers are related to one another.

One-to-one counting

The mathematical thinking skills of the early childhood can be developed through counting. Counting is another important aspect of learning in early childhood mathematics, the meaning attached to counting is the foundation for the children in developing mathematical concepts or ideas upon which every other number concept is based. One-to-one counting focuses on how to develop the ability of the early child in counting. Here two skills are required; **(i)** the ability of the child to say the counting words in order **(ii)** the ability of the child to relate each of the spoken number with one and only one object. Young children usually learn how to count by memorizing but they need to understand the counting through counting skills in a different meaningful way. The mathematics teacher needs to teach the young children how to count beginning from smaller numbers and once they are able to grasp and master the counting of smaller numbers then, their knowledge can be extended to the number sequence of counting both forwards and backwards, from any given number.

Counting from one to solve another problem

Solving problems by counting enable the young children to understand that counting is useful and can be used in many situations.

Counting of objects can be used to solve addition and subtraction problems. Whatever materials the children may be playing with can be used to draw their attention to help them understand that addition and subtraction problems can be solved through their counting skills. The children can be asked to add up or subtract two different sets of numbers. For example, when the children are asked to add up 4 and 3. First of all the children will start by counting out “1, 2, 3 and 4” using either pebbles or their fingers for the first number, thereafter count out “1, 2 and 3” for the second number. The two sets of numbers are then joined together and counting all together as “1, 2, 3, 4, 5, 6, 7” to add up 7. They can also be asked to take away 3 from 4. In this case the children will count 1, 2, 3 and 4 either by using their fingers or pebbles, then take away 1, 2 and 3 from it and count the remaining number to be “1”. With the first and second illustration, the children will be able to understand that by joining small sets of number with total of seven and by taking away one number from the other to get one they can solve addition and subtraction problems. This will also assist them to count different concrete materials to solve number problems which will eventually help them to understand that counting is not just to memorize only but it can be used to solve mathematical problems. The importance of counting from one to solve number problems develops children’s mathematical skills and help them understand addition and subtraction operations using counting skills to combine and separate groups of objects. Through the counting, young children will understand that when group of objects are joined together, the objects increases, and also when the objects are separated, the objects decreases. In this process the children acquire the knowledge of addition and subtraction operation.

Some methods of teaching mathematics at the early childhood

The purpose of teaching mathematics in schools is to assist the young children develop or acquire mathematical skills needed for them to succeed in their education, being useful to themselves and contribute to the progress of society. There is need for the young children to appreciate, develop interest in mathematics and be more attentive to its teaching (Onoshakpokaiye, 2010). The mathematics teacher needs to use good teaching strategies that will stimulate and facilitate mathematics learning by the young children. There are various approaches that the mathematics teachers can adopt in the teaching and learning of mathematics. Reginald (1980), defined methodology as the method by which materials are being presented to the students and also engaging them with the work before them. Okpala (2006) stated that teacher must select the method that is best and appropriate for a particular situation or activity to be carried out by the teacher and the student.

Inductive methods: According to Okpala (2006), the inductive method starts from specific to general that is from the known to unknown and concrete to abstract. By using this method, the young children are given a number of specific problem and then required them to find the general solution to it. In inductive method laws are generated from particular cases by searching out patterns for the given circumstance. Okpala (2006) sees inductive as a process whereby the young children discover things and it is a discovering method. The inductive method give the young children an ample opportunity to discover things such as new concepts, laws, truths and easy or suitable methods for solving mathematical problems and also finding solutions to the mathematical problems without the assistance of their teachers.

Activity method: Another useful method that can be used in teaching mathematics at the early childhood is the activity method. Onoshakpokaiye (2010), stated that activity method is a situation whereby the young children are given mathematical problems to solve in order to keep them busy. It is a very useful method in the teaching and learning of mathematics. In this method the young children are given sets of mathematics puzzles to solve and allow them to work on their own without much supervision by their teacher. For this method to be effective in the teaching of mathematics, the teachers must not solve every exercise and the students should not be passive, exercises should be given to them to practice so as to keep them busy and able to learn. This is where the saying ‘practice makes perfect’ comes into play. Practicing exercises is very important in the teaching/ learning of mathematics. When a child is able to solve given exercises, it motivates, make the child to be happy and make him/her develop more interest in the learning of mathematics. When mathematics is understood by the young children and also knows the rules for solving mathematics problems, it makes the lesson to be more interesting to the students and both the teacher and students are happy, therefore making teaching and learning to be effective. According to Okpala (2006), the activity method assists in building competency and sense of self-expression in the young children and also helps as means of acquiring practical experience.

The inquiring and heuristic method

Ezenweani (2006) stated that the process of inquiry involves allowing the young children to search out information themselves. This method gives the young children ample opportunity in gaining scientific attitudes. This method enables the young children to explore, measure, observe, classify, and predict, experiment and so on. He went further to say that pure inquiring

method allow the young children to carry out the above activities through trial and error.

Conclusion

Laying strong foundation on the early childhood mathematics is of great importance towards the success of the child in their education and future life. Building Positive attitude in the young children and solid foundation in learning mathematics from early childhood cannot be overemphasized. This is the stage where solid foundation in mathematics can be built. The government, curriculum expert and mathematics teachers need to know the developmental stages of the young children to be able to plan and teach them so that mathematics can be meaningful to them. The teachers should also ensure that the foundation is properly lay otherwise there will be problem in their future life. This is the stage where mathematical concepts and skills can be developed in them to carry on to higher level of education. To achieve the objectives of the education in Nigeria. There must be proper teaching at this level for effective learning.

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