

REJUVENATING THE TEACHING OF PRIMARY MATHEMATICS THROUGH THE USE OF MANIPULATIVES

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Abstract

This paper discussed the idea of rejuvenating the teaching of mathematics through the use of manipulatives. Manipulative was defined as tangible instructional materials which can be used to improve the teaching and learning of mathematics at primary school level of education. It opined that the use of these method would shift mathematics teaching from being teacher centred to being learners centred bearing in mind that it would arouse pupils interest in the learning of mathematics and subsequent improvement on their performance in it. It identified high cost of manipulatives, non-availability of some manipulatives in the local market, non-availability of mathematics laboratory for storage of manipulatives and non-acquisition of relevant skills in use of manipulatives by practising teachers as challenges, while government provision of subsidy on manipulatives, provision of mathematics laboratory in primary schools, importation of unavailable manipulatives, retraining of practising mathematics teachers are recommended to tackle the challenges.

Keywords: Mathematics, Manipulatives, Teaching, Learning, Challenge.

Introduction

Mathematics is the science of quantity and space. It is a systematized, organized and exact branch of science. A creation of the human mind, concerned primarily with ideas, processes and reasoning. It includes arithmetic, algebra, geometry, calculus, statistics and probability. It is the branch of human enquiries, involving the study of numbers, quantities, data, shapes and space and their relationships, especially their generalization and abstractions and their application to situations in the real world (Clapham & Nicholson, 2009). Mathematics is a language of communication in the field of science. The need for mathematics has been as old as mankind. It has been instrumental to transforming man's rural society to modern society and being the basis of science which is the bed rock of modern development, it is recognized that the intensity of socio-economic emancipation of any country is closely linked with the degree of development of the country's mathematical science. No nation can develop without a substantial input in mathematics education. A country's progress is attached to the worth of its human resources which is a critical factor of production and development. Mathematics is used all over the world as an essential tool in many field including natural sciences, medicine, engineering and social sciences. It has an important role in the development of science and technology. It is essential for understanding of every discipline. Without the knowledge of mathematics, it is difficult to understand other aspects of learning.

Primary education is the first stage of education, coming after kindergarten and before secondary education. It is an educational system that takes place in primary school. The

National Policy on Education (NPE) define primary education as education given to pupils between the ages of 6 to 11 years of age. It runs from primary 1 to primary 6. It is the key to the success or failure of the whole system of education because it is at this level that the foundation of all levels is built. Primary mathematics also known as elementary mathematics is the study of mathematics topics that are commonly taught at the primary level of education. These are the mathematics topics that pupils are expected to learn from primary 1 to primary 6.

The main goals of teaching mathematics at the primary level are to help pupils to acquire:

- The basic skills in numeracy.
- The ability to use the skills to solve problem.
- The ability to interpret graphs and arrangement of numerical data. (NOUN PED 144).

To achieve the goals stated above, the following topics were put together for primary school pupils as the primary mathematics curriculum, number and numeration, basic operations, measurement, algebraic process, geometry and mensuration and everyday statistics.(NOUN, PED 144)

Looking at the goals stated above, one will see that the role of primary mathematics in achieving the objectives of primary education is inevitable. It is at this level of education that pupils are introduced to the basic operations and ingredients of mathematics and their application to day to day activities. It is a fundamental stage as far as the study of mathematics is concerned and if pupils are not properly taught, they may not find it easy in secondary school and other levels of education. One major way of having an effective teaching and learning of mathematics in primary school is by the use of manipulative.

Concept of Manipulatives

Manipulatives are objects, charts and activities that engage learners while helping them develop their mathematics skills. Larbi&Marvis (2016), define manipulative as objects that can appeal to several senses and that can be touched, moved about, re-arranged and otherwise handled by pupils. It is a piece of equipment created so that a learner can use it to manipulate some mathematical idea to understand it (Muktar&Faruk, 2023). They are concrete learning materials that allow pupils comprehend abstract concepts through concretizing them. Manipulative are object that is designed so that learner can perceive some mathematical concept by manipulating it. Istiandaru et al (2017) defined manipulative as a teaching aid designed such that students could understand mathematical concept by manipulating it. It plays an important role in helping pupils to learn by allowing them to move from concrete experiences to abstract reasoning. Sten&Bovalino (2001) opined that manipulative can be important tools in helping students to think and reason in more meaningful ways. By giving students concrete ways to compare and operate on quantities, such manipulative as pattern blocks, tiles and cubes can contribute to the development of well-grounded interconnected understanding of mathematical ideas. The role that manipulative played in the life of pupils is so enormous that teaching without it will be like a tailor sewing without a machine. Boggan et al (2010) acknowledged that manipulative enables students to integrate their knowledge and associate them with their thoughts in order to understand mathematical concepts thoroughly.

Literature Review

Manipulative and Primary Mathematics Teaching and Learning

Manipulative in the content of education are physical tools of teaching, engaging pupils visually and physically with objects such as coins, bottle tops, blocks, puzzles, markers etc. The use of manipulative is constructivist because pupils are actively engaged in discovery during the learning process. The power of using manipulative is that they let the pupils connect mathematical ideas and symbols to physical objects, thus promoting better understanding. By using physical models to represent thinking, they can move and adapt the materials as they explore possible solutions to problems. Concrete materials are imperative for exploration and experimentation with mathematics ideas as pupils develop meaning. Manipulative are effective in that they are multisensory, represent ideas in more than one way, they promote communication among pupils and they increase confidence, leading to less confusion and a deeper understanding. Using manipulative in teaching mathematics concepts has several benefits for primary school pupils, among these are:

- **Manipulatives Increase Conceptual Understanding:** Manipulatives help learners develop a concrete understanding of abstract mathematics concepts. By physically manipulating objects, pupils can better grasp the meaning behind mathematical operations and relationships. For instance, students can use blocks to understand multiplication and division, number lines to understand addition and subtraction, and patterns to understand fractions. By providing real representations of abstract ideas, students can better understand the underlying concepts and make learning more meaningful and effective.
- **Manipulative Increase Pupils level of Engagement in the Class:** Manipulatives make learning mathematics more engaging and interactive. They can help pupils stay focused and interested in the subject, leading to better retention of the concepts being taught. It gives learners the opportunity to be actively engaged in learning at their own pace, hands-on learning approach help students internalize mathematical ideas and increase their motivation to learn.
- **Manipulative Support Different Learning Styles:** Different pupils have different learning styles and manipulatives can cater for all these learning styles and this can make mathematics more accessible to a wider range of students. For example, students who are visual learners can benefit from manipulatives that provide visual representations of mathematical concepts. Meanwhile, students who are kinesthetic learners can benefit from manipulatives that allow them to physically manipulate mathematical objects.
- **Manipulatives Improve Pupils Problem Solving Skills:** Manipulative can promote the development of problem solving skills by allowing pupils to experiment with mathematical ideas in a hands-on way. By being actively involved in problem-solving activities, students can improve their ability to think critically and independently.
- **Manipulatives Connect Pupils to Real World Application of Mathematics:** Manipulatives can help pupils see the real world application of the mathematics concepts they are learning, making the subject more relevant and practical.
- **Manipulative Encourage Collaboration and Communication:** When manipulative are used in group settings, it encourages collaboration and communication among pupils as they work together to solve problems.

Manipulatives are objects that is designed so that a learner can perceive some mathematical concepts by manipulating it. Experts agreed that the use of manipulatives is an important instructional tools to help students bridge the gap between the concrete and the abstract level. Primary school teachers need to restructure their classroom to incorporate the use of mathematics manipulatives. Manipulatives in a mathematics class increases pupils understanding and engagement (Cockett& Peter 2015). When a teacher uses manipulatives, there will be activities like moving around, turning, screwing items to make it fit, cutting of items, etc, which makes learners active and increase their participation and interest in the classroom. Manipulatives help students learn by allowing them to move from concrete experience to abstract reasoning. Its importance in a mathematics classroom cannot be side-lined, pupils understanding and development in a mathematics classroom are greatly helped by the use of manipulatives.

Evangeline (2020), conducted a research on the use of manipulatives in teaching elementary mathematics found out a significant mean gain difference in the pupils' posttest and pretest scores in mathematics exposed to manipulatives and conventional method, the study advised that teachers in elementary class should employ the use of manipulatives in mathematics classroom. Mukthar, Muhammad &Faruk (2023), conducted a research on the effect of using manipulatives on the performance of pupils in primary school in Kebbi state, the result of their research revealed that the use of manipulatives in a mathematics class has a positive effect on pupils' performance, the study advised that manipulatives should be used as much as possible when teaching mathematics in primary school.

Hakki (2016), carried out a research on the effect of manipulatives on mathematical achievement and attitudes of secondary school students towards mathematics found out that the pretest and posttest means differ significantly, the posttest has a higher mean than the pretest. Aburime (2007), carried out a research on the place of geometric manipulatives in secondary schools. The research was conducted on JSS 2 students in Edo state, the study revealed a significant difference between the mathematics achievement of students taught with improvised geometric manipulatives and other students, the study advised that authorities concerned should help in providing manipulatives in our secondary schools.

Cockett& Peter (2015), in their study examined the impact of using manipulatives in mathematics on students understanding, efficiency, engagement and enjoyment in a lower primary classroom, the researcher engaged 32 students in various activities involving different kinds of manipulatives and the result showed that students are more engaged when using manipulatives and that their perception of the learning environment improved in the areas of enjoyment, understanding and efficiency.

Sample of Manipulatives that can be used to Teach Mathematics in Primary Schools

Pattern blocks: Pattern blocks are made of plastic or wood and comes in a variety of shapes, like triangle, square, rectangle and trapezoid, these manipulative is perfect for geometry lesson. Pupils can experiment with how these shapes can be used to form another shape or images. These blocks often come with pattern cards that guide pupils on how to make pictures and create their own pattern. It can also be used to teach pupils fraction and counting.

Cuisenaire Rods: These are rectangular rods of various lengths, often made of wood with different colours, each length corresponds to a different colour. For instance, all red can be 15 units long, all green 10 units long and all yellow 5 units long. This colourful manipulative can be used to teach number line, pupils can find the distance between numbers and see the relationship numbers have with each other e.g it can be used to find the number of times 5 can go in 15 by using the rod. They can be used to teach basic number sense, fraction etc.

Abacus: An abacus is a calculation tool used by sliding counters along rods or grooves. It is used to perform mathematical functions like addition, subtraction, multiplication, division and roots of numbers.

Fraction Tiles and Fraction Circle: These are flat rectangular pieces of plastic or cardboard made of different colours and varying lengths with their corresponding fraction printed on them for easy comparison for pupils. Pupils can use these tiles to learn how to add fractions to become whole numbers or another fraction. Fraction circles are similar to fraction tiles, but instead of rectangle they use part of a circle.

Place value blocks or base ten blocks: Place value blocks are base ten blocks are plastic blocks connected to each other to topics like addition, subtraction, fraction, measurement and place value.

Geoboards: These are small wooden or plastic pegboards that use string or rubber bands to create a variety of shapes. They are great hands-on activity for practicing shape recognition and names. It can also be used to find perimeter and area of shapes.

Two colour counters: They are simple plastic circles with one colour on each side. They are mostly used to demonstrate fractions, basic addition, subtraction and counting skills. They are often magnetic, this makes it easy to be used on white board markers and for activity games. Other manipulative that can be readily available are bottle tops, fruit seeds, pegs for holding clothes

Challenges of Manipulatives

Despite the numerous importance of manipulatives in teaching manipulatives in primary school, there are also some challenges that needs to be looked into. Some of these challenges were cited by Amelia et al (2022) as stated in Camelia (2023) are:

- **Cost:** One of the biggest challenges of using manipulatives is cost. Manipulatives can be expensive, especially for schools with limited budgets. Manipulative purchasing costs can be prohibitive, especially for schools in low-income areas.
- **Storage:** Another challenge is storage. Manipulatives come in all sizes and shapes and are difficult to store when not in use. This can be especially challenging for schools with limited space.
- **Limited Availability:** Manipulative availability can also be a challenge. Schools may have difficulty finding the right manipulatives for their teaching concepts. In some cases, manipulatives may not be available for purchase or must be ordered in advance.

- **Teacher Training:** Another challenge is teacher training. Teachers need to be trained on how to effectively use manipulatives in the classroom. This takes time, effort, and resources.
- **Resistance from Students:** Some students may resist using manipulatives in class. For example, students may find manipulatives too childish or may feel that manipulatives are not necessary for their learning. Teachers must be able to deal with this problem effectively and involve students in using manipulatives.
- **Cultural Differences:** Manipulatives may also have cultural differences. For example, some manipulatives may not be culturally appropriate for certain groups of students. Teachers need to be aware of these cultural differences and ensure that manipulatives are used in a culturally sensitive way.
- **Inadequate Implementation:** Finally, manipulatives may not be used effectively in the classroom. Teachers may not use manipulatives in ways that encourage active and engaged learning.

Conclusion

The paper opined that teaching and learning of mathematics is indispensable to a purposeful educational system. It identified manipulatives as a method of teaching mathematics which has to do with objects, charts and activities that engage the learners' attention during the teaching of mathematics. Though defined by many authors, the basic definition is tangible objects that can arouse pupils interest in learning of mathematics. The paper concluded that use of manipulatives transforms mathematics teaching from teacher centeredness to learners' centeredness. The involvement and participation of pupils in mathematics, makes mathematical concepts real instead of being abstract like before. The paper equally identified cost, storage, limited availability, teacher training, resistance, cultural differences and inadequate implementation of the method as challenges.

Recommendations

The following recommendations are made with the hope that it would help a lot in promoting the use of manipulatives in mathematics teaching.

- Government at all levels of education should subsidized the cost of mathematical instructional materials. Inasmuch as agricultural inputs are subsidized by government, local and international agencies, the same thing should apply to the educational sector.
- Mathematics laboratory should be available in our primary schools. Relevant instructional materials can be stored in such laboratories for proper safe keeping. This would enable the same set of materials to be used by different set of pupils for many years.
- Manipulatives that are not available locally should be sourced from abroad. Concept of shapes like pie is strange to pupils from rural areas. Having contact with such object which are part and parcel of mathematical manipulatives will actually redefine the concept of mathematics teaching and learning.
- Mathematics teacher should be properly trained on how to handle these manipulatives because many of the present teachers actually had no contacts with manipulatives as students and somebody cannot effectively teach others what he does not know how to do. A good training for teachers of mathematics would actually be the game changer.

References

- Aburime, F.F. (2007), The Place of Geometric Manipulatives in Secondary School Mathematics in a Democratic Nigeria. *Global Academic Group*.
<https://www.globalacademicgroup.com>
- Bogan, M. Sallie, H. & Anna, W. (2010), Using Manipulatives to Teach Elementary Mathematics. *Journal of Instructional Pedagogies*. 3(1).
- Bovalino, J. W., (2001), Manipulatives: One Piece of the Puzzle. *Research Gate* 6(6). DOI. 10.595/MTMS.6.6.0356 <https://www.researchgate.net>.
- Camellia T. (2023), Effectiveness of Using Manipulatives in Mathematics Teaching In Inclusive Education Program in an Elementary School. *DE-JOURNAL (Dharma Education Journal)*.<http://ejournal.undhari.ac.id/index.php/pldejournal> E-ISSN:2722-7839 4(1) 108-178
- Claphman, C & Nicholson, J. (2009), The Concise Oxford Dictionary of Mathematics. 4th Edition. <https://www.oxfordreference.com>.
- Cockett, A. & Peter, W.K (2015), Mathematical Environment: Creating an Environment for Understanding, Efficiency, Engagement and Enjoyment.
- Evangeline, B. (2020), The use of Manipulatives in Teaching Elementary Mathematics. *International Journal of Linguistics, Literature and Translation (IJLLT)*. ISSN: 2617-0299. DOI:10.32996/ijllt.
- Federal Government of Nigeria (2013). National Policy on Education. 6th Edition.
- Federal Government of Nigeria (2012). National Open University of Nigeria (NOUN). Student Course Book (PED 144). www.noun.edu.ng.
- Hakki, K. (2016), The Effect of Manipulatives on Mathematics Achievement and Attitudes of Secondary School Students. *Journal of Education and Learning*. 5(3). ISSN 1927-5250.Canadian Center of Science and education.
- Istindaru, A. Istihapson, V, Rully, C &Fariz, S. (2017), Characteristics of Manipulatives in Mathematics Laboratory. *Journal of Physics Conference*. 943(1): 012023. DOI:10.1088/1742-6596/943/1/0/2023.
- Larbi, E. &Marvis, O. (2016), The use of Manipulatives in Mathematics Education. *Journal Of Education and Practice*. ISSN 2222-1735 17(36).
- Mukthar M.S, Muhammad S.A &Faruk A. (2023), The Effect of Using Manipulatives on the Performance of Pupils in Primary School Mathematics. *Journal of Mathematical Science and Computational Mathematics*. 4(2): 223-232. DOI: 10.15864/mscm.4206.