TOWARDS PRACTICAL MATHEMATICS: AN EXAMINATION OF REAL WORLD GEOMETRY AND MENSURATION IN NIGERIA

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INTRODUCTION

The undesirable weak performance of students in mathematics, especially at the post-primary school level is a global issue. Many factors have been associated with this weakness. The most popular of the numerous factors available in literature include students' attitude towards mathematics, the nature of mathematics and the curriculum. In Nigeria, varied efforts have been made in the past by researchers in the educational institutions, professional associations like the Mathematical Association of Nigeria (MAN), the Science Teachers Association of Nigeria (STAN) and the Federal Ministry of Education (FME) to encourage and promote mathematics education. For instance, in the seventies such efforts led first to the introduction of Modem Mathematics and later to the scrapping of it from Nigeria secondary schools in 1977 and in its place is the current mathematics curriculum produced by the Federal Ministry of Education. However, with the new curriculum in operation for over fifteen years, examination results from the West African Examination Council (W AEC), a body which is responsible for conducting certification examination for secondary school graduates in the whole of West Africa, reveals that the situation is still bad (see Tables 1 and 2 below).

Table 1 - Bauchi State S.S.C.E*. 1990, 1991 and 1992 results

Subject	Year	Total Sat	% of credit pass (1 - 6)
Mathematics	1990	5,065	1.7
	1991	4,845	4.2
	1992	5,766	6.8

* SSCE means Senior Secondary Certificate Examination

Table 1 is for Bauchi State, one of the educationally disadvantaged or backward states in Nigeria. Nigeria has thirty one states, including the Federal Capital Territory (FCT). On the national level the results for two years is as shown in Table 2.

Table 2 - *GCE/'O' Level Results Nov./Dec. 1990 and SSCE Aug./Sept. 1991

Subject	Year	Total Sat	% of credit pass
Mathematics	Nov. '90	242,209	24.4
	Aug. '91	294,079	11.1

* GCE means General Certificate Examination. It is equivalent to SSCE.

Obviously, the situation of mathematics education in Nigeria is poor and the generality of the factors responsible centres around the learner, the teacher and the learning environment.

From my experience as a mathematics educator and teacher trainer who has participated in a series of workshops such as the Teachers Vacation Courses (TVC) which is an annual programme by the ministry of education for secondary schools teachers, the teachers often point accusing fingers at their students claiming that the students are not serious about the study of mathematics. On the other hand the students always express their view about mathematics as "an abstract" subject in nature and presentation (Ale, 1987).

Although the debate on the nature or philosophy of mathematics is not something that this paper is meant to draw any conclusion on, I consider the psychology of the learner and societal values as necessary variables. In this respect, all of the following questions impinge on the resolution of the problem:

1. What is mathematics?
2. Why do we teach mathematics?
3. Has mathematics got anything to do with the outside world viz-a-viz man's day to day activities and experiences of the physical world?
4. What aspects of school mathematics can be related to the outside world?
5. How can we relate the mathematics to the learner's environment?
6. How can we relate mathematical symbolism to the concrete world?
7. How can we show the students that mathematics is not abstract or 'not absolutely abstract' ?

Many descriptions of mathematics have been given in literature and usmg some of the descriptions such as: (a) mathematics is the queen of science. (b) mathematics is the bedrock of all the sciences, the 'absolutist' view of mathematics as a body of infallible and objective truth is something to ponder upon (Ernest, 1991). If mathematics is the Queen and/or bedrock of science, it implies that mathematics is science, possibly super science. Denotatively, science is a "systematised knowledge derived from observation, study and experimentation carried on in order to determine the nature or principles of what is being studied" (Webster's Dictionary 1979 as quoted in Schoenfeld 1994). This empirical characteristic of science is found in Biology, Chemistry, Physics, Agriculture and Geography through their practical lessons in Nigeria secondary schools and this is perhaps a basis why the students do not view these subjects as abstract relative to mathematics.

Therefore, I feel that the exploration/utilisation of such practical approaches can serve as a motivator for the learning of mathematics. Examples of what activities are possible within the Nigeria secondary school mathematics from the section on Geometry and Mensuration of the Schools' mathematics curricula are enumerated in the next paragraph. It is necessary to note that Geometry has been found to be one of the most difficult areas of the mathematics curriculum for the students in Nigeria (Okwonkwo 1994) and Mensuration has always been involved with geometry throughout history (Baron, 1973).

Practical Examples for Teaching Scale Drawing (age 13-14)

Scale drawing and the concept of scale is used to cope with meaningful representation and interpretation of situations where either we are faced with too large a quantity to be accommodated in a limited space or too small a quantity that inhibits visual perception. Such situations are practicable in Bauchi state of Nigeria using, for example, the number of pens of a cattle rearer to determine the number of cattle he has. Bauchi state is predominantly occupied by the Fulani people whose occupation is farming and cattle rearing.

Thus, if it is known that a pen can only take 20 cattle, students would be made to make a survey of the farms of cattle rearers, determine how many cattle they have and how many pens are there or if a person has K pens how many cattle are there? This introduces the idea of the ratio 1 :20 so essential in scale drawing. This can then be followed up with actual drawing, so that a 1 cm line segment can be labelled as 500 km hence they can determine the true distance of a 2 cm line segment or an Ncm line segment.

In a similar way, students were made to visit market places to investigate the following problems. "How many' mudus' (a unit of measure in the Northern part of Nigeria) are there in a 50 kg. bag of 'gari massara' (i.e. maize flour).

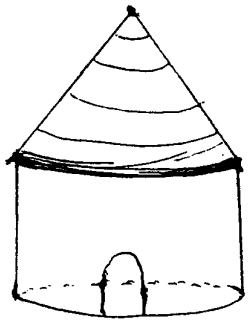
How many bags are required for say 5,000 mudus of gari massara? How many mudus can be obtained from K bags of gari massara (where K is positive integer)?

The activities were chosen based on what the students are familiar with in their environment. The grasp of the concept that scales are means of representing information to meaningfully suit or fit available accommodation can be used to extend to the mathematical symbolisms.

Identification of Shapes (Age 13-14)

Another consideration that was made concerned identification of some three dimensional structures in their real form within the student's environment. The figures identified were pyramids and prisms. Intuitively, the concepts of pyramids and prisms can be acquired from observation of the typical traditional buildings (Huts) of Fulanis. The shape usually appears like the sketched figure 1 below.

Figure 1



(A sketch ofa typical traditional Hut common in the Northern part of Nigeria)

Also, during the harvesting session, farm produce such as groundnuts, millet, cotton or com are bagged and piled up in shapes of pyramids. Conical anti-hills are also very common in Nigeria. Students were made to observe these real world mathematical shapes pointing out their characteristics that make each shape unique from others.

Though the observed real world structures are often not as in the refined shapes that we use in the teaching and learning of mathematics, the basis for doing mathematics can be understood by the students. For instance when I asked the students to find out the number of bags in a pile of a groundnut pyramid formed on a square base and of about 30 metres high the response was that "this is too tedious because we cannot count all the bags without dismantling the pyramid and there are too many of the bags". This response can now be used to justify the importance of mathematics and its symbolisms which students often term formulae. Helping the students to see that for any prism, the quantity of unit measures that make the prism is called its volume and the volume can be obtained by determining the number of units in a cross section of the prism (say the base) and multiplying it by the number of times you can get such cross-section from the height of the prism.

It should then be possible to move to the more abstract idea of using a cuboid as an example for prisms with the number of unit cubes that fills a cuboid of given dimensions further confirming with the explanation.

Pyramids are slightly harder but filling a model pyramid with sawdust and tapping it into a prism with same base and height will introduce the multiplying factor of one third.

Conclusion

I have stated earlier that the main trust of this paper is not on what kind of philosophy of mathematics to uphold. Rather I have attempted to make a case for directing the minds of mathematics educators and mathematics curriculum planners in Nigeria towards designing activities for practical mathematics. I have only touched on a small unit of the mathematics for the Nigerian secondary schools and I am aware that not every aspect of mathematics concepts can be 'practicalised' but through collaborative efforts the practicals in the 'Queen', the bedrock, the cornerstone of science (i.e. mathematics) can be exploredlutilised in the teaching and learning of mathematics.

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