STEPS TO IMPROVE THE TEACHING AND LEARNING OF BASIC GEOMETRY IN SECONDARY SCHOOL FOR THE ATTAINMENT OF SEVEN POINT AGENDA

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ABSTRACT

This paper examines the reasons on and how study of geometry can serve as a vehicle for the improvement of mathematics teaching and learning. It explores how it is an agent toward attainment of the seven points agenda. Specifically the paper stressed that the study of geometry provides necessary skill and abilities needed by all Nigeria populace for a meaningful and productive life in the modern world of science and technology. It also highlighted some identified problems in teaching and learning of school geometry and suggested some geometry Teaching and learning strategies were discussed such as integration of historical and cultural assets of pasts geometrics ideals/thoughts in classroom lessons, demonstrating the understanding and meaningfulness of geometry, developing the learners intuition by drawing meaning and imagination from models to concrete object through carefully teacher planned and implemented lesson structure which should be gender sensitive. The paper concluded by emphasizing the central role of the teacher as a facilitator while the learner move from active participation to achiever. Finally useful recommendations were made.

1.0 Introduction

For many years now the factors that affect and promote effective teaching and learning of mathematics have continued to receive attention from the mathematics educators and psychologist, Odili (2006) and Orton (1992). Also, available literatures suggest that issues such as mathematics teacher preparation, teachers methods of teaching, availabilities of teaching materials, new technologies and lesson structures etc as it relates to mathematics were researched and reported on. In addition, research suggest that all these have impact on the students learning, Swafford et al (1997).

However, the recognition attached to mathematics cannot be over emphasized. This is due to the fact that mathematics provides the laws, the formulas and the theorems that empower the scientific and technological developments, Musa (2006). Therefore, the need for improvement in the teaching and learning of mathematics based on the ultimate human right to quality life improvement obtained from developments in science and technology. Wasagu (2007) buttressed this and said, "We live in an age of escalating global interdependence and competition, both of which affect education. Acute changes in competition are creating an increase demand for educated and technically competent individuals. No segment of human activity has been left untouched by the result of scientific thought. Rapid changes in science and

technology of which mathematics is the pivot have dictated the developmental prospects of many nations. Consequently, countries which have made substantial investment and have strategically managed science and technology have been able to significantly raise their material welfare and invariably the quality of life of their populace. This is the goal of Seven Point Agenda using Education to provide qualitative and functional education to the Nigerian populace. Hence the search for means to improve mathematics teaching for the attainment of Seven Point Agenda has become very necessary. Therefore, this paper will focus on the geometry aspect, which serves among other things as a unifying theme to the entire mathematics curriculum and as a tool for developing students' skills in logical and deductive reasoning.

2.0 Nature Of Geometry

Geometry by its nature and inherent structure, according to Fajemidagba (1992) is a branch of mathematics which involves the study of spatial relationships (position, shape and size). Its study is carried out through observations, constructions and description of shapes and location of points in 1 or 2 or 3 dimensional spaces.

From this, it can be deduce that study of geometry provides skills in visual, verbal, drawing, logical and applied. These are necessary skills and abilities needed by all for a meaningful and productive life in the modern world of science and information technology. Indeed, these geometrical skills should be sufficient for our students so that they can function successfully as informed consumers, as concerned citizen and as competent members of their communities. Hence, geometry by its nature and inherent structure is important and indispensable branch of mathematics which needs to be properly taught by the mathematics teacher.

3.0 Reasons for Teaching Geometry in Secondary Schools.

1. Geometry is an aid for communication example we speak and write in geometrical vocabularies such as point, line, angle, parallel etc.
2. Geometry has importance applications to real life contexts such as in measurement around our homes.
3. Geometry has important application to many topics in mathematics example Arithmetic, Algebra, and statistical concepts where giving geometric interpretation.
4. Geometry provides a valuable mathematical background for further education example in U.K it is a prerequisite for university entrance.
5. Geometry is part of cultural heritage of community.
6. Geometry provides a context for developing students' logical reasoning skills.
7. Geometry enhances the development of students' spatial perception and understanding.

4.0 Lessons Learnt in Geometry Teaching and Learning

The pictures emerging from research reports shows that students have difficulty in solving mathematics problems especially those that require mental manipulation, rearrangement of elements with visual stimuli – pattern. Just as teachers have problems teaching that area. In particular, WAEC examiners'

report (2005, 2000, 1996 and 1995) revealed that students have problems with geometric area of mathematics and such problems have been traced to lack of essential rudiments of geometry at lower levels. Reports cited above revealed that students have difficulty to accurately measure, draw, construct, and even to arrange objects – virtually students suffers of skills and abilities needed in the study of geometry.

In many schools both at primary and secondary levels, due to the low level of geometry knowledge of many teachers and the lack of teaching and learning materials and teachers' lack of knowledge of improvisation of teaching materials in geometry, teachers low knowledge about the psychology of learning geometry pupils/students have no idea of the basic principles and knowledge at their level. The type of teaching process adopted by the teacher based on lecturing and memorizing by students/pupils is not helping the understanding of basic geometry.

The students/pupils tend to learn by heart geometry lessons and be able to reproduce what is read or written by mathematics teachers. It is a kind of black box method, where the teacher describes the box, but he/she not able to understand what is inside. (Camara, 2006). To attain the Seven Point Agenda, today more than ever, the pupil/students should be educated by the mathematics teacher in away to understand what is inside the black box. This is applicable to all levels of education. For example, Fajemidagba (1987) reported that, the teaching of geometry at secondary school level requires that mathematics teachers are well equipped to deliver. But a look at the mathematics education programme in Nigerian universities and Colleges of Education showed that geometry is not emphasized. It is certainly true that mathematics teachers cannot deliver what is not emphasized. Invariably, poorly trained mathematics teachers will no doubt produce poorly motivated mathematics students with low mathematics achievement. And negative attitude towards mathematics, by reason, this syndrome is carried over to geometry. Ohakwe (2006).

5.0 Suggested Strategies to Improve the Teaching of Geometry.

5.1 The Historical Reflections

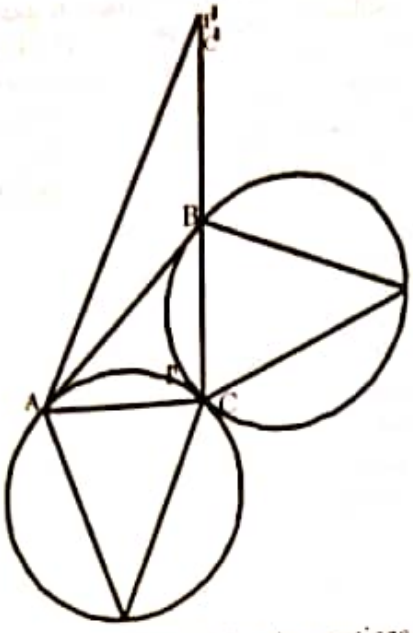
In the hand of well prepared mathematics teacher geometry lessons at the primary and secondary levels becomes not only important but also raises their curiosity in learning. This is because geometry is a good preparation of historical reflections to understanding immediate environment especially from the time of Greeks to Egyptians. The immediate environment is built of shapes and space. We live in the world abounds in geometric form. Learners can see circles in coins, wheels, cylinders in three trunks and tiles etc. example, over the years, Greeks and Egyptians used geometry to reshape societal values, belief and concerns and influenced economic activities and development. In particular, Greeks perceived geometry as a vehicle to enhance deductive reasoning/thinking. While the Egyptians use their study of geometry in the observation of boundaries in the over flood of the Nile River. Also they accurately obtained the construction of pyramid and ability to arrive at elegant and powerful method to determine perimeter, area and volume of pyramids and frustum. All these were done with a view to quality

life improvement. Similarly, Balakar (2006), reported an indigenous group called Munduruki, who lived in isolated villages in several Brazilian states in the Amazon jungles, who have no words in their language for square, rectangle or any other geometrical shapes except circles. They had no measuring instruments or compasses, no maps in their words for directions but are limited to sunrise, sunset, upstream and downstream. The Munduruki's language has few words for numbers beyond five. Except "few and many and even these words are not used consistently. Yet researches suggest that, they appear to understand principles of geometry as well as American children do and in some cases as well as American adults. Also, result of an investigation to test the understanding of geometry revealed that Munduruki's children score the same as American children 64% while Munduruki adults scored 83% compared with 84% for the American adults. Here, it could be deduced that

1. the idea that an understanding of geometry may be a universal quality of the human mind. This date back as far back as the time of Plato.
2. Balakar (2006) said, people learn things after all just by living in the world. However, the argument raised by this, is "we do not know whether this core knowledge is present very early on young subjects or to what extent it is learned. The writers concluded by saying that, Munduruki's do interact with 3-D objects, manipulate and navigate the complex environment. Therefore, it can be deduced from this narrations that, a major lesson in geometry is the need for integrating cultural assets in order to enhance effectiveness. The teacher has to facilitate the integration of life experiences and positive values in handling geometry lessons. Acquiring these values by the learners would lead to community development and qualitative societal transformations as the only language and culture common to all studies, (Kurumeh, 2006). Thereby leading to achieving the Seven Point Agenda.

5.2 Understanding the Meaningfulness of Geometry

Understanding the meaningfulness of geometry in relation to everyday life and to the major challenges facing the society is a crucial dimension of any effective teaching and learning. Providing a meaningful experience of deductive reasoning for students. If geometry help improve the quality of life, learners should be guided by the mathematics teacher how it is possible. The mathematics teacher as translator of the curriculum and who must have mastered the curriculum content should put at the back of his mind that every topic in geometry addressed at least, a specific developmental issue either at local or national level. Research suggests that the more topics are meaningful to the learner, the more effective is the learning and the motivated are the learners. Butler et al (1970). For example, three villages are to be connected to national Grid, where should the power plant be located in order to use the least amount of high voltage cable that will feed electricity to the three towns/villages.



If the three towns are represented by the vertices of a triangle, ABC, then this problem can be solved by finding a point with minimum sum of distances to all 3 towns/villages. Students can measure the three distances from an arbitrary point P, and the vertices A, B, C of the triangle. They can then sum these distances and move P around to find location with minimum sum. When such point is obtained, students can make conjectures concerning relations among P and the three vertices. Many students conjectures have been to see if any of the known triangle centres satisfy the minimum sum requirement (e.g. in centre, centroid or circum centre). Some of these may appear to work for certain triangles, but not for others. Eventually, some students will notice that the angles formed by point P and each pair of the vertices appear to be the same. Measurements would indicate that they are close to 120°. Various construction methods arise.

1. Construct an equilateral triangle on 2 sides of the triangle ABC and then construct the circum circles of this equilateral triangle. Where the circum circle intersects will subtend 120° with each side of the triangle.

Fig. 1

Question: why this point provides the minimum sum of distance to each vertex of the triangle formed by the 3 towns/villages?
The question is challenging that students will be eager and willing to find out. However, the most satisfying explanatory is one that makes use of the fact that the shortest distance between two points is along a straight path between the two points.

The above argument appears logical and inform as well as explanatory. It therefore comes as a surprise to most students to learn that the power plant should be built in the centre of town B, rather than at P.

5.3 Developing Students Intuitive Skill

Intuition is regarded as a skill to see clearly geometric figures and solids, creating and manipulating them in the mind to solve problems, Fujita et al

(2004). Intuition is as essential skill in geometry especially at primary and junior secondary school level. Literature suggest that geometry teaching and learning in the 20th century does not only aim at developing students' logical way of thinking but also include developing students' ability to see the real world mathematically. This, the mathematics teacher can achieve through various practical task such as drawing, measurement, and imagining and manipulating figures.

Example: formation of new geometrical figures by using triangles.

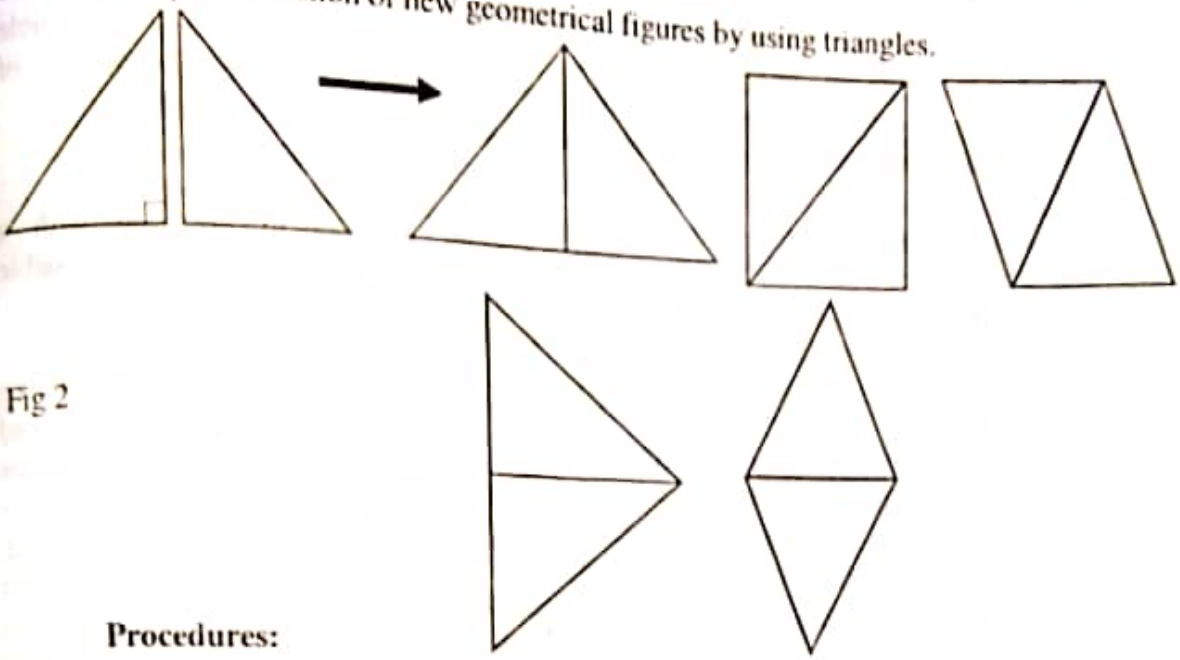


Fig 2

Procedures:

Introduction

This unit draws attention to the aspects of developing students intuition using practical and intuitive approach.

Objectives:

At the end of this unit you should be able to:

1. Developmentally introduce new plane figures.
2. Stimulate students spatial imagination

Presentation

1. The introduction of students imagination skills is to ask students to imagine a triangle in their mind.
2. Next, using concrete model of triangle, students were asked to find relational positions ie sides etc.

Stage II:

1. Student could be asked to manipulate them in their mind.
2. Students could be asked to turn-over figures (reflections) to move new figures.

Stage III

1. Students could be asked to draw ale the possible combinations of triangle they have imagined in their minds. Students should be able to come-up with the following new figures fig. 2 (plane figures) as a result of possible reflections.

Summary

The teaching of geometry which starts with the imagination then followed with models (concrete) and asking students to create "inner intuition" of the possible combinations of such figures as in the figures (fig 2) above makes students be aware of thinking about plane figures. This is appropriately tasking to the student it became qualitative and functional. Hence, there is the need for mathematics teacher to prepare activities that can faster participation and raised interest among the learners. Therefore this approach calls for a possible blend of experimental intuition (mental) and deductive approaches of geometry lessons at primary and secondary school levels.

Conclusion

Through these activities studies should be able to come-up with a diagram/figures of new plane geometrical figures from all possible construction of triangles

Students have to manipulate them in their heads – aimed at stimulating students' spatial imagination. Students have to turn-over figures (reflection) when they try to make new figures. This led them to think about plane figures in space. Through the activity, they may be able to imagine all combinations of figures (geometrical shapes) and manipulate such activities in their mind. Research suggests that learning process should be active to allow learners participation. In participating they learn more. Hence, drawing meaning and imagining promote active leaning of geometry. Hence there is the need for mathematics teacher to prepare activities that can foster participation and raised interest among the learners. It contributes to make learning of geometry interesting to the pupils/students. Hence the teaching of geometry which start with models then to concrete and is appropriately tasking to the students becomes qualitative and functional.

5.4 Lesson Structure and Gender Sensitive

Research suggests that teaching methods and how teachers structure their lessons to develop geometrical reasoning are related in terms of students learning. Jones, Fujita and Ding (2004). Consequently, it has implication on students achievement in geometry. Trends International Mathematics and Science Study (TIMSS) suggest that two predominantly teaching methods accounting for nearly class time on average internationally appear to be teacher lecture (23%) and teacher guided practice (22%). While 60% of students say that discussing homework and working independently are also frequent activities in class. Also, it was reported in TIMSS that general features of mathematics lessons were shared across countries for example, 80% of lesson time is devoted to solving mathematics problems. Lessons were organized to include some public-class work and aid some private students work, most individual but with some involving small groups. Most lessons include some review of previous content as well as some attention to new content. Teachers across the counties reported by TIMSS were formed to talk more then their students (with a ratio of at least 8:1 words). The issue of geometry teaching continues to be an area of considerable international concern, especially given its role in developing students' powers of reasoning.

Literature shows that student fail to see a need for proof and are unable to distinguish between forms of mathematical reasoning such as explanation, argument, verification and proof. Jones, Fujita, and Ding (2004) said, range of things are likely to influence the ways in which mathematics lessons are structured. These include examinations, curriculum, textbooks, research in learning and teaching, of characteristic of each area of mathematics, etc. and invariably have a bearing on the way teachers might structure their lessons. Noting that lessons in geometry is quite different from those in number and numeration. Then why routine procedures for geometry lesson as observed by the writers. Therefore to improve the teaching of geometry there is the need for the mathematics teachers to develop their lessons based on shared general features and discernible variation. Distinction should include how new content should be introduced, the coherence across mathematical problems and within presentation (i.e. the interrelation, both implicit and explicit, of the mathematical components of the lesson), regarding individual student work and home work in class. See a model of lesson structure on corresponding angles, alternative angles and interior angles. **See Appendix**

Similarly, the mathematics teacher needs to be sensitive. This is due to the fact that, a classroom can be active with dynamic participation of only a proportion of the students. Especially, when girls were not carried along or victims of stereotypes, the learning is not effective to them. Also if the activities selected are not to their interests, there will be no active participation. Literature suggest that, female participation in Science, Technology and Mathematics is low, Okeke, 1986; Ekuri and Windopo, 2000; Camara, 2006). This imbalance needs to be addressed. Hence geometry teaching can be improved, if geometry learning taking place be gender sensitive. Thereby reducing the gender gap in both enrollment and active participation in Science Technology and Mathematics education as reported in above mentioned literatures. Consequently, this led to attaining the visions of Seven Points Agenda.

6.0 Conclusion and Recommendations

In conclusion, the teaching of geometry with emphasis on skills inherent in its study such as visual, drawing, logical thinking and applied which study of geometry provides are necessary skills and abilities needed by all Nigerian populace for a meaningful and productive life in the modern world of science and technology. Hence its improvement in teaching and learning can serve as a preparatory vehicle for the attainment of Seven Point Agenda. In particular when the central role of mathematics teacher becomes that of facilitator and the students from active participant to achieve. Hence, through historical reflections understanding the meaningfulness of geometry, developing students' intuition, lesson structure and gender sensitivity would serve as a means to improve geometry teaching and the learners become meaningful and productive individuals. Therefore the following recommendations were made:

1. Mathematics teacher preparation in colleges of education and universities must emphasize more on geometry contents and its pedagogy
2. the serving mathematics teachers should have a paradigm shift from teacher-lecture to teacher facilitator and students shift from active students to achieving learner. In particular, the mathematics teacher should be a mastered in designing practical tasks that would effectively develop students' imagination skills in geometry.

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