

IS TEACHERS' KNOWLEDGE A REASON FOR STUDENTS' POOR PERFORMANCE IN LATITUDE AND LONGITUDE IN NIGERIA SECONDARY SCHOOLS?

C.A. Akintade¹; U.I. Ogbonnaya² & D Mogari¹

¹Institute of Science and Technology Education, University of South Africa

²Tshwane University of Technology, South Africa

calebayodele@gmail.com; ogbonnayai@tut.ac.za; mogarld@unisa.ac.za

Abstract

Latitude and Longitude, is one of the topics in mathematics in the West African Examination Council syllabus. Over the years, chief examiners' reports reveal that students' performances in the topic have been generally poor. This study sought to find the reasons for students' poor performance in the topic from teachers. A random sample of 100 Mathematics teachers from 20 secondary schools in four Local Government Areas of Ogun State, Nigeria participated in the study which employed descriptive survey research design. Data was collected using Teacher Questionnaire on Reasons for students' Poor performance in Latitude and Longitude (TQRPLL) and analysed using descriptive statistics. Findings revealed that most of the teachers lacked understanding of the topic and find it difficult to effectively teach it. Based on these findings, it is recommended that the topic should be included in the teacher education curriculum as it is currently not taught at the universities or colleges of education where the teachers are trained.

Key words: Latitude and Longitude, Mathematics, Nigeria, Teachers knowledge,

Introduction

In Nigeria, high premium is placed on the teaching and learning of mathematics in schools. That is why mathematics is a compulsory school subject at the primary, junior secondary and senior secondary school levels (that is Grade 1 – Grade 12). However, students' performances in the subject have been below expectation. This has been a great concern to many mathematics educators and Education stakeholders.

A five-year report on the performance of students in mathematics in the West African Examination Council (WAEC) senior school certificate examinations between 2007 and 2011 revealed that a high proportion of students failed the subject. This implies that majority of the candidates that wrote the examination did not score up to 40% in the subject hence are not admissible into institutions of higher learning. For example, in 2007, 53.2 % of the candidates that wrote the examination failed. In 2008, 42.7% candidates failed. Similarly, 53.0%, 58.0 % and 61.8 failed the subject in 2009, 2010 and 2011 respectively (see WAEC, 2012).

Although students' performances in mathematics in past years have been generally poor, the WAEC chief examiners reports over the years indicate that Latitude and Longitude is a major problem area for the students (see, WAEC, 2007; WAEC, 2010). According to the chief examiner, the students fail to understand the question and hence do not address them adequately. As observed by Ashiaka (2010), this is an indication that either the teachers avoid teaching the topic, or that they do not teach it well, or that the students find the topic difficult to understand.

The performance of students in any topic or subject can be attributed to the teaching and learning factors within and outside the classroom or school environment (Ahmad, 2008; Ingvarson, Beavis, Bishop, Peck, & Elsworth, 2004). However, teachers are key players in students' learning (Ball, Hill & Bass, 2005; Rohaan, Taconis & Jochems, 2010), they are important source of evidence of their teaching (Cranton, 2001) that is unobtainable from any other source. Hence, this study explores if teachers' knowledge is a reason for students' poor performance in latitude and longitude in Nigeria secondary schools.

Latitude and Longitude

Latitude and Longitude is a topic under Mensuration according to the WAEC syllabus. Latitude is a geographic coordinate that specifies the North-South position of a point on the Earth Surface. If the Earth is cut perpendicular to the polar axis, the circles formed on its surface are called lines of Latitude (Macrae, Kalejaiye, Chima, Garba, Ademosu, Cannon, McLeish Smith, Head, 2009). Is (Latitude) is an angle which ranges from 0° equators to 90° North or South at the Poles. It is the angular distance measured north and south of the equator (Harwood, 2011). As one goes north of the equator, the latitude increases up to 90 degrees at the North Pole. Similarly, as one goes south of the equator, the latitude increases up to 90 degrees at the South Pole. In the northern hemisphere, the latitude is always given in degrees north and in the southern hemisphere it is given in degrees south. Longitude on the other hand, is a geographic coordinate that specifies the East –West position of points on the Earth Surface. It is an angular measurement, usually expressed in degrees. A point with the same longitude runs from North Pole to the South Pole. The Longitude of other places is measured as an angle East or West from the Prime Meridian; ranging from 0° at the Prime of Meridian to $+180^\circ$ Eastward and -180° Westward. Harwood (2011) describes Longitude as angular distance measured east and west of the Prime Meridian (Greenwich Meridian). The prime meridian is 0 degrees longitude. As one go east from the prime meridian, the longitude increases to 180 degrees and as one go west from the prime meridian longitude increases to 180 degrees. The 180 degree meridian is also known as the

International Date Line. In the eastern hemisphere, the longitude is given in degrees east and in the western hemisphere it is given in degrees west. Figure 1 shows the lines of latitude (horizontal lines) and lines of longitude (vertical lines) on the earth surface.

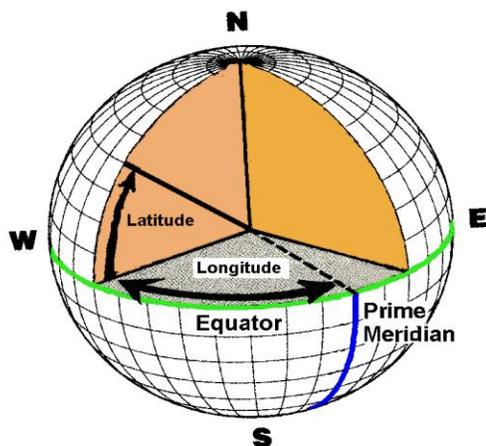


Figure 1. Latitudes and Longitude on the Globe

Lines of longitude are also referred to as **Meridians** and **Great Circles**. Great Circles are defined as "any circle on the surface of a sphere, especially when the sphere represents the Earth, formed by the intersection of the surface with a plane passing through the centre of the sphere. Any path which follows a great circle on the surface of the Earth will be the shortest possible distance between two points.

Students in Nigeria, according to the National Mathematics Curriculum for Senior Secondary School (NMCSS) and in line with the WAEC Syllabus, are to be taught the following aspects in Latitude and Longitude.

- Distinguish between great circle and small circle on the surface of the earth.
- Define the lines of Longitude (including the Meridian) and Latitude (including the Equator) on the surface of the earth.
- Determine and sketch the position of a point on the Earth Surface in term of its' Latitude and Longitude (e.g. 14° N, 26° E and 37° S, 106° W).
- Calculate the distance between two points on the Great Circle (Meridian) or the Equator.
- Calculate the distance between two points on a parallel of Latitude.
- Calculate the shortest distance between two points,
- Compare great circle and small circle route on the surface of the earth (Macrae, et al., 2009, p.53).

Conceptual background

Many factors affect students' learning and achievement. However, teachers seem to have the most significant effect on students' academic achievement (Ball, Hill & Bass, 2005). In mathematics, the role of the teacher includes helping students understand the subject-matter of mathematics by presenting it in ways meaningful to students. For students to perform well in mathematics, they need to understand the substantive syntactic structures of the subject and this can only be achieved by teachers that have good mastery of the substantive syntactic structures of the subject (Tsang & Rowland, 2005). Such teachers, because of their understanding of the subject will present it in a way that the students will be able to construct their own understanding. This implies that mathematics teachers need thorough understanding of the subject matter and also knowledge of how to address the subject matter in their classes. In line with this, Shulman (1986) argues that "teachers must not only be capable of defining for students the accepted truths in a domain, They must also be able to explain why a particular proposition is deemed warranted, why it is worth knowing and how it relates to other propositions" (p. 9).

Many scholars view the knowledge that teachers need for effective teaching as being categorised into content knowledge and pedagogical knowledge. However, some other scholars like Shulman (1986) believe that the two kinds of knowledge are inseparable rather they interact together as pedagogical content knowledge (PCK) to enable teachers to teach effectively. He argued that PCK is the content knowledge that deals with teaching because PCK enables the transformation of the subject matter knowledge into pedagogically useful forms. Therefore, strong and useful pedagogical content knowledge depends on strong knowledge of the content (Rohaani, Taconis & Jochems, 2010; Smith, 1999) and pedagogical knowledge. This tends to suggest that the student's poor performance on Latitude and Longitude may be due to teachers' inadequate knowledge of the topic.

Methodology

Study population and sample

The population of the study was Senior Secondary School Mathematics teachers in Nigeria. Ogun state was chosen for the preliminary study because of its cosmopolitan nature in terms of ethnic background of the inhabitants. A random sample of 120 Mathematics Teachers from 20 secondary schools in Four Local Government Areas of Ogun State were chosen for this study. A total of 120 questionnaires were administered but only 101 (84.17%) were completed and returned back. During data cleaning, it was discovered that one of the questionnaires was partially completed therefore it was discarded. Of the 100 used questionnaires, 55 (55%) of the respondents were females while 45 (45%) were Males.

Research design

This study explores if teachers' knowledge is a reason for students' poor performance in latitude and longitude in Nigeria secondary schools by gathering information from many teachers using a survey questionnaire .Hence, the study adopted survey research design (Creswell, 2008).

Data collection instrument

Data was collected using Teachers Questionnaire on Reasons for students' poor performance in Latitude and Longitude (TQRPLL) which was developed by the researchers by adopting suitable statements from attitude questionnaires such as those in Choi & Cho,(2002); Shankar *et al.*, (2005) and also by working in consultation with some mathematics teachers. Three mathematics teachers and two mathematics education researchers validated the construct of the instrument and made suggestions that were used to revise the instruments before the collection of data. The final instrument consisted of two sections. The first section was on teachers' demographic data: (Gender, Qualifications, and years of experience in the teaching of mathematics) while the second section was a 25 items, 4-points (Strongly Disagree, Disagree, Agree, and Strongly Agreed) Likert scale type instrument requiring teachers to indicate their levels of agreement or disagreement with statements about the reasons for students' poor performance in the Latitude and Longitude. The 25 items focused on teacher knowledge (subject matter knowledge and teachers' pedagogical knowledge), students' attitude, teaching resources, parental influence and the examination body. The reliability (Cronbach alpha value) of the instrument on the aspect of teacher knowledge was 0.70 hence the instrument was found reliable (Ahmadian, Abu Samah, Emby & Redzuan, 2010; Nunnaly, 1978) for the purpose of the study.

Data analysis

The TQRPLL scores formed the basis of data analysis. Descriptive statistics was used to analyse the data collected.

Findings

Table 1 shows the teachers' responses to the six items relating to teachers' knowledge (Pedagogical and content Knowledge) as reasons for students' poor performance in Latitude and Longitude (N =100).

Item	Statement	No of teachers			
		S A	A	D	SD
1	<i>Many Mathematics Teachers lack pedagogical approach to the teaching of Latitude and Longitude.</i>	12	53	13	22

2	<i>Some Mathematics teachers do not understand Latitude and Longitude hence; they skip it.</i>	11	46	22	21
3	<i>Latitude and Longitude is difficult to explain to students by many teachers because it is not clear enough to them.</i>	17	36	31	16
4	<i>Many of the teachers handling Mathematics in most of the Secondary Schools are not professionally qualified.</i>	32	36	15	17
5	<i>Bearing, which is requisite to understanding Latitude and Longitude is not taught by many teachers. This is because they lack knowledge of the topic.</i>	17	43	27	13
6	<i>Many Mathematics teachers in the Secondary School considered the contents of Latitude and Longitude too wide to handle.</i>	15	40	30	15

The above six items were analysed using frequency and percentage. For the purpose of this analysis, the affirmatives ‘strongly agree’ and ‘Agree’ were collapsed to ‘Agree’ while the non-affirmatives ‘strongly disagree’ and ‘Disagree’ were collapsed to ‘Disagree’ as often used in educational research studies (e.g. Mogane & Atagana, 2010).

The Table shows that:

Out of the 100 teachers, 65 teachers agreed that many of them lacked pedagogical approach to the teaching of Latitude and Longitude (Item 1). Only 35 teachers disagreed that many of the subject teachers lack pedagogical approach to the teaching of the topic. This high rate of the respondents’ agreement to item 1 shows that many of the teachers lack the pedagogical approach of teaching the topic.

To Item 2 (*Some Mathematics teachers do not understand the concept of Latitude and Longitude hence, they skip it*), 57 out of 100 teachers representing 57% agreed that the concept was not understood by many teachers while 43 (43%) disagreed that some mathematics teachers do not understand the concept of Latitude and Longitude hence they skip the topic. The spread of the score is moderately favourable. This indicates that the concept of the topic is likely not well understood by some teachers hence they skip the topic.

To Item 3 (*Latitude and Longitude is difficult to explain to students by many teachers because it is not clear enough to them*), 53% of the respondents agreed that the topic is difficult to explain

to the students while 47% opined that the topic is not difficult to explain to the students. The spread of the scores is moderately favourable since greater percentage of the teachers indicated that it is difficult to explain to students.

Sixty eight percent of the respondents were in agreement that '*Many of the teachers handling Mathematics in most of the Secondary Schools are not professionally qualified*' (Item 4). The spread of the scores is greater than 60 which according to Mwei, Wando, & Too (2012) is most favourable indicating that most of the teachers handling the subject are not professionally qualified.

Similarly, majority of the teachers (60%) agreed that *Bearing, which is requisite to understanding of Latitude and Longitude, is not taught by many teachers because they lack knowledge of the topic* (Item 5). The spread of the score is favourable (Nbani, 2012), which indicated that most teachers did not teach bearing which is requisite to the understanding of Latitude and Longitude.

Fifty five percent of the respondents agreed that they considered the contents of Latitude and Longitude too wide to cover (Item 6). The spread of this score is moderately favourable according to Manoah, Indoshi, & Othuon (2011) which is an indication that the content is wide for most of the teachers to cover.

Discussion

The study investigated if teachers' knowledge is a reason for students' poor performance in latitude and longitude in Nigeria secondary schools. The spread of the scores indicated that most of the teachers lack pedagogical approach to teach the topic. When teachers lack the approach to teach a particular content, it will be difficult for them to transform content knowledge into a form that can be understood by students (Shulman, 1986). This will lead to over reliance on algorithms and rule in the textbooks without any innovation that can arouse students' interest to learn (Nyaumwe & Ngoepe, 2010). The end result of such teaching will be students learning by rote and mass failure in examination. On the contrary, when teachers have sound pedagogical approach to teaching a topic they will likely offer quality instruction that would promote students conceptual understanding and eventually lead to students success in examination.

The teachers' responses to Items 2 and 3 show that most of the Mathematics teachers do not understand Latitude and Longitude. They find it difficult to explain to students because of the shallow knowledge they have of the topic. Many studies have shown that for teachers to teach effectively they need to have good mastery of the content (Tsang & Rowland, 2005). This knowledge enables the teacher to adopt teaching practices that help students to relate with topic and hence construct their own knowledge. Where this is lacking, a teacher will either avoid

teaching the topic or rely on textbooks in his or her lesson delivery. The parallel found in the teachers' responses to Item 2 and Item 3 clearly indicated that most of the mathematics teachers are struggling with the subject content of Latitude and Longitude. This is not surprising because one can only explain what one understands to other person (Kousar, 2010). This possibly explains why many students do not perform well in the topic and why many of them believe that the topic is difficult.

The participants' response to the statement that "*many Mathematics teachers consider the contents of Latitude and Longitude too wide to handle*" was also found to be in consonance with their responses to Items 2 and 3. This was not also unexpected because lack of understanding of a topic will lead one to believe that the topic is difficult to teach and also makes one see the topic to be wide to contend with. There is no wonder then that the participants responded in similar manner to the three items which is an indication that teachers' knowledge is a major reason for the students' poor performance in the topic.

Majority of the respondents agreed that students' poor performance in Latitude and Longitude was as a result of many professionally unqualified Mathematics teachers in the classroom. This was not unexpected because of the shortage of qualified experts to teach mathematics in the country. As in many other countries, most teachers teaching mathematics did not study or major in mathematics or mathematics education at the tertiary education level. Many of them are graduates of other disciplines that opted (or were co-opted) to teach mathematics in the wake of the shortage of qualified mathematics teachers (Fatade, 2012). Therefore, it is likely that such teachers may not have acquired much mathematical knowledge to handle challenging topics like Latitude and Longitude.

The teachers' response to the statement that "bearing, which is requisite to understanding Latitude and Longitude, is not taught by many teachers" was sixty percent on the affirmative. This could be one of the major challenges to the teaching and learning of Latitude and Longitude in Nigeria. Bearing is one of the topics in plane geometry. In bearing, students are taught to use angles to identify the location of an object with reference to another, locate the positions of objects, and find distances of object from other object. The knowledge of 'bearing' is needed for one to be able to locate positions of objects on the globe. This implies that bearing serves as foundation for students to master Longitude and Latitude easily. Therefore, if students are not taught bearing, they will not likely understand Latitude and Longitude and consequently they will perform poorly in the topic in the examination.

Recommendations and Conclusion

Based on the findings of this study, it is concluded that teachers' knowledge (content and pedagogical) are possible reasons for students' poor performance in Latitude and Longitude. Hence, we recommend that Latitude and Longitude should be included in the curriculum of mathematics teachers training both at the colleges of education and the universities as the researchers observed that the topic is currently not part of the teacher training curriculum in the country.

The findings also point to the need for periodic seminars and workshops for subject teachers with emphasis on the topics that they teach in the curriculum. Education stakeholders like the government at various levels, the Mathematical Association of Nigeria (MAN) and Science Teachers Association of Nigeria (STAN) should wake up to the challenges of poor performances of students in mathematics in general and this topic in particular by organising content and pedagogical training workshops and seminars for the teachers to boost their content knowledge of the subject and their pedagogical approaches to the topics.

Finally, it is worthy to note some of the limitations of this study. The sample used in the study was drawn from a state out of the 36 states in the Nation. This suggests that future research on this aspect should try to overcome the limitation of the study by expanding its scope to cover many other states. There may also be the need to measure teachers' knowledge of the topic to ascertain if teachers' knowledge is indeed a reason for students' poor performance in latitude and longitude in Nigeria secondary schools

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