Journal of Education and Practice
ISSN 2222-1735 (Paper) ISSN 2222-288X (Online)
Vol.4, No.12, 2013

Students and Teachers' Views of Difficult Areas in Mathematics Syllabus: Basic Requirement for Science and Engineering Education

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Abstract
The research investigates teachers and students' views of difficult areas of mathematics syllabus which is a special requirement for engineering education in Nigeria using Ogbomosho South Secondary Schools in Oyo State as case study. The population of the study consisted of all the mathematics teachers and all the senior secondary III students in all the 18 Secondary schools in the Local Government Area. A simple random sampling technique was used to select 15 mathematics teachers and 180 Senior Secondary school III Students. Two self designed questionnaires were developed to elicit information for the research questions. Appropriate hypotheses were raised based on the research questions. These questionnaires were validated and their reliability ensured. The data gathered were analyzed using frequency count, percentage, t-test and Chi-square. The results of the analyses revealed that both teachers and students, qualified and unqualified, experienced and less experienced teachers have the same views of difficult areas in teaching and learning of mathematics in the secondary schools. Based on the findings, it was therefore recommended that for engineering education to advance, teachers should endeavour to improve themselves academically, be more committed, proactive in their dealings, and see their job as service to humanity; school authorities should have more time schedule for mathematics on the time table, qualified mathematics teachers should be posted to all schools, appointment of mathematics teachers should be purely on merit and should not be politicized. Curriculum planners should be up and doing in planning for teaching of mathematics with appropriate instructional materials.
Keywords: Teachers, students, perceptions, mathematics, curriculum, hypotheses, T-test, Chi-square, Evaluation,
Recommendations

1. Introduction

1.1Preamble

Mathematics is a powerful tool and gate keeper for success in life. It is as old as man himself. There is a common saying that mathematics is the mother of all subjects, but the poor performance of students in Nigerian senior secondary school mathematics examinations is nowadays becoming alarming and therefore becomes imperative for whosoever have passion for education to be gingered towards improving the pathetic condition. Efforts in this direction gave the required initial motivation to the study of science, which deals with the influence of conceptual knowledge shared by an intellectual community on the activities of the community (Unoroh, 2004). The Federal Government of Nigeria in order to equip students to live effectively in the modern age science and technology lays emphasis on science education which is taught at all levels of education and made compulsory at both primary and secondary schools. At tertiary level, it is part of General Studies for students (Ivowi, 2000). For admission purposes into tertiary institutions, the ratio of science to liberal arts is 60 to 40 percent with functionality and integration of theory and practical as paramount aims. In the submission of Hewson and Thorley (1989), the intelligibility of a concept can be assessed by the following criteria.

(1) Does the learner know what it means?
(2) Do the pieces of the conception fit together for the learners?
(3) Is the learner able to find a way of representing the conception?
(4) Can the learner begin to explore the possibilities inherent in it?

It follows therefore that a better understanding of any topic lies on the personal interpretations or construction that people make of it. It had been investigated and shown that low performance of students in the subjects at the senior school certificate examinations was due to lack of qualified teachers, low level interest and commitment on the part of students, the abstract nature of some of the topics, teachers poor knowledge of the subject matter, non-availability of resource materials and over loaded curriculum (Adeyegbe, 1994). Ivowi

(1993) in his paper asserted that the three traditional science subjects of mathematics, chemistry and physics are abstract in nature and therefore difficult to easily grasp by students.

1993 report of The Nigerian Educational Research and Development Council (NERDC) identified 12 difficulty areas in the senior school mathematics. Ogunsola (2004) researched into gender sensitivity in classroom teaching and learning; stated that gender stereotyping of disciplines influence male and female enrolment in schools. Abel (1994) looked into teachers' perception of general nature of science.

Yap and Lim-Teo (1999) conducted a study on mathematics teachers' perceptions of their preparedness for teaching and likewise is the work of Leitzel(1991). Variables such as years of teaching experience and qualification of teachers have been considered important. This is because there are authors who believe that qualification and teaching experience of teachers influence students' performance (David 2004), while there are authors who disagreed. The present study was undertaken to identify the levels of difficulty of mathematics topics as viewed by teachers and students in the mathematics teaching syllabus for senior secondary schools in Ogbomosho South Local Government Area.

Existing theories about how children learn have been classified in various ways, and they have a significant bearing on how mathematics is taught (Cathcart et al, 2011). Today most mathematics educators believe that student construct their own knowledge as they interact with their environment (Von Glasersfeld, 1989; Baroody and Coslick, 1998).

Brooks and Brooks (1999) contended that our perceptions and knowledge are continuously shaped by social factors. Apart from constructing knowledge individually, people construct knowledge socially. Through interaction with the environment, individuals continue to construct new knowledge. Phillips, 2002 looked into the effects of gender differences on the knowledge and perceptions that individuals possess in business mathematics.

Bojuwoye (1985) noted that Nigeria science education is facing a serious peril because of the dwindling number of Nigerian youths both at secondary and post secondary education levels willing to make science study their major preoccupation. He stressed further that the academic performance of students in secondary schools has been very poor in recent times especially in mathematics.

Eniayeju & Eniayeju(1994) were of the opinion that the trend under the achievement of science, Technology and Mathematics(STM) if not arrested, the intended positive outcomes derivable from the science for all philosophy might be doomed to naught.

Oyedeji(1992) studied the influence of gender and teaching experience on teacher's perception of difficulty in primary mathematics curriculum. The result of his findings showed that teacher's gender and teaching experience did not significantly affect the participation of difficult topics.

Jones (l995) recorded that "teachers with deeper understanding of mathematics tend to tailor their teaching to more conceptual views while teachers with a lesser knowledge of mathematics tend to use a more rote structure", an observation which is also true in their experience of supervising trainee teachers in Singapore.

Yap and Lim-Teo(1999) carried out a study on mathematics teachers' perceptions of their preparedness. They employed teachers that were graduates from local or foreign universities who had undergone the one-year postgraduate diploma in education course at the National Institute of Education in Singapore. In their findings it was discovered that majority found the teacher preparation useful but there were certain topics in mathematics or certain approaches where they would like to have further training.

Ibrahim (1995) looked into the influence of gender and teacher effectiveness on student's perception of mathematics class taught by male and female teachers in secondary schools in Irepodun Local Government Area of Kwara State, Nigeria. He discovered that there was no significant difference in the students' perception of diversity in mathematics classes taught by male and female teachers.

The studies of Fox and Soller (2001) have shown that the learning styles of boys are generally different from the learning styles of girls. They stated that boys and girls prefer competitive and cooperative learning respectively. In addition, perceptions of boys toward mathematics are different from those of girls, which seem to be likened to perceptions of gender roles and career aspirations.

1.2. Purpose of the study

The general purpose of the study was to identify levels of difficulty of mathematics topics as perceived by senior secondary school teachers and students. Specifically, the study examined;

(1) The perceived levels of difficulty of mathematics topics by teachers in the senior secondary school mathematics syllabus.

(2) The perceived levels of difficulty of mathematics topics by students in the senior secondary school mathematics syllabus.

(3) The influence of teachers' qualification on the perceived levels of difficulty of mathematics topics in the senior secondary school mathematics syllabus.

(4) The influence of gender on teachers perceived levels of difficulty of mathematics topics in the secondary school mathematics syllabus.

(5) The influence of teaching experience on teachers perceived level of difficulty of mathematics topics in the senior secondary school mathematics syllabus.

(6) The influence of gender on students' viewed levels of difficulty of mathematics topics in the senior secondary school mathematics syllabus.

1.3. General Questions

The study attempted to find answers to the following questions:

(1) What is the difference in the levels of difficulty of mathematics topics as viewed by teachers and students?

(2) What levels of difficulty do mathematics teachers' perceived mathematics topics in the senior secondary school?

(3) What levels of difficulty do mathematics students viewed mathematics topics in the senior secondary mathematics syllabus?

(4) What influence would teachers' qualification have on their perceived levels of difficulty of mathematics topics in the senior secondary school mathematics syllabus?

(5) What influence would teachers' gender have on their perceived levels of difficulty of mathematics topics?

(6) What influence would teachers' teaching experience have on their perceived levels of difficulty of mathematics topics in the senior secondary school mathematic syllabus?

(7) What influence would gender have on students' perceived levels of difficulty of mathematics topics in the senior secondary school mathematics syllabus?

(8) What is the difference in the reasons given by mathematics teachers and students in their perceived levels of difficulty of mathematics topics?

1.4. Research Hypotheses

The following hypotheses were generated and tested for the study:

$H0_1$: There is no significant difference in the perceived levels of difficulty of mathematics topics by mathematics teachers and students in the senior secondary school mathematics syllabus.

$H0_2$: There is no significant difference in the perceived levels of difficulty of mathematics topics by qualified and unqualified mathematics teachers.

$H0_3$: There is no significant difference in the perceived levels of difficulty of mathematics topics by male mathematics teachers and their female counterparts.

$H0_4$: There is no significant difference in the perceived levels of difficulty of mathematics topics by experience and less experience mathematics teacher.

$H0_5$: Male mathematics students are not different from their female counterparts in their perceived levels of difficulty of mathematics topics.

$H0_6$: There is no significant difference in observed reasons for perceived levels of difficulty of mathematics topics by teachers and students.

1.5. Scope of the Study

The scope of the study was limited to the senior secondary class 3 (SS3) students and teachers of mathematics in all 18 secondary schools in Ogbomosho South Local Government. The SS3 students were appropriate because the students have been taught all topics in SS1and SS2 mathematics syllabus, and have registered mathematics in their senior school certificate examination. They were therefore familiar with the syllabus.

1.6. Significance of the Study

The identified levels of difficulty of mathematics topics would serve as very useful and strong tools to the classroom teachers, students' curriculum developers', mathematics textbook authors, school authorities and educational researchers. The uniqueness of this study is that it extends the search for levels of difficulty of mathematics topics to teachers of mathematics who are WAEC markers in the SSCE mathematics.

Consequently, the findings of this study would be useful to classroom teaches in creating awareness to mathematics teachers about the importance of organizing workshop, seminars and probably in-service training as an avenue to learn more on how best these difficulty topics can be taught. The findings would also be useful to students in creating early awareness of careful study and allocation of quality time on such difficulty topics so as to encourage preparedness.

Curriculum developers and planners may also derived immense benefits from the findings of the study in the sense that, it would enable them to possess knowledge and disposition to develop methods and activities that would promote students' inquiry that can enhance students' understanding of mathematics topics. Also, textbook authors would benefit from the study because they may see the need to shift emphasis from teacher activities to student activities. It would also sensitize mathematics textbook authors on the need to incorporate workbooks along textbooks to enhance class participation and problem solving skills in the learning of mathematics.

The study would further assist school authorities in allocation of quality time to mathematics lessons through extra lesson or tutorial. The findings may help investigators by providing useful information upon which future research studies in the area of levels of difficulty of mathematics topics can be based.

2. Research Methodology

The study is a descriptive survey type of research which attempted to obtain the perceptions of students and teachers as expressed by their opinion. The investigation elucidated the possible influence of teachers' qualification, gender and teaching experience on levels of difficulty of mathematics topics in senior secondary school syllabus.

2.1. Research Population

The targeted population for the study was all the mathematics teachers and students in the 18 senior secondary schools (SSS3) in Ogbomosho South.

2.2. Sampling Techniques

Random sampling technique was used for the study. Of the 18 senior secondary schools in the local government, 15 schools were selected for the research work. A total of 15 mathematics teachers and 180 (SSS3) mathematics students served as the sample for the study.

2.3. Research Instrument

Two sets of questionnaires were designed by the investigators for the study because it has capacity to elicit responses from person on a wide range of events (Jimoh, 1995). The first is, the mathematics teachers' questionnaire (MTQ), which consists of three (3) Sections: Section A deals with general personal information about the teachers. The information includes teachers' sex, educational qualification, year of teaching experience and school location.

Section B is made up of twenty (20) topics obtained from senior secondary school mathematics curriculum. While section C consists of a list of 5 reasons of perceived levels of difficulty by mathematics teachers.

A second set of questionnaire is the mathematics students' questionnaire (MSQ).The questionnaire has been designed to consist of three parts. Part A deals with the specific background information about the student which would include: school location, class, sex, subject and age. Part B Is made up of the 20 topics as in mathematics teachers' questionnaire.

Part C consists of five reasons for perceived levels of difficulty by mathematics students

2.4. Procedure for Data Collection

The questionnaires were directly administered by the researchers to the subjects with the assistance of the mathematics teachers in the sample schools. This was done after relevant consultation with the appropriate school authorities and permission obtained. The responses were collected back by the researchers immediately after completion by teachers and students.

2.5. Data Analysis Techniques

The data collected were analyzed by using descriptive inferential statistics, such as frequency count, mean, Chi Square - test and T-test. Research question 2 and 3 were analyzed using frequency count and mean, while hypotheses 1-6 were analyzed using Chi Square test and T-test. T-test was used to analyze hypotheses 2,3&4 because of low number of samples that was involved while Chi Square test was adopted to analyze hypotheses 1,5&6 because of the large size of sample involved. The reason for perceived levels of difficulty was also analyzed using the mean. The mean of teachers and that of the students were compared to ascertain if there is any relationship.

3. Results and Discussion

The results of the analyses are presented following the sequence of responses to the questionnaires based on the questions raised. The null hypotheses 1-6 were tested at 0.05 level of significance using t-test and Chi test. Mean was used to analyze questions 2, 3 and hypothesis 6 respectively.

Eight out of a total of 15 teachers administered with a mean of 0.53 perceived construction and loci as the most difficult topic to teach while fraction, decimal, number bases and percentage as the least difficult.

Out of 180 students administered 140 students with a mean of 0.78 perceived Construction and loci as the most difficult topic to learn. Indices, logarithms, Fraction, decimal, number bases and percentage with a frequency count of 14 and mean value of 0.08 was viewed by the students as the least difficult to learn.

Hypothesis 1

There is no significant difference in the perceived levels of difficulty of mathematics topics by mathematics teachers and students in the senior secondary school mathematics syllabus.

The results obtained show that at 0.05 significant level, $X^2_{tab} = 30.14 > X^2_{cal} = 19.96$ and since the calculated value is less than the table value the hypothesis was not rejected. Hence there is no significant difference in the perceived levels of difficulty of mathematics topics by mathematics teachers and students.

Hypothesis 2

There was no significant difference in the perceived levels of difficulty of mathematics topics by qualify and unqualified teachers.

Table 1:- t-test summary table for perceived level of difficulty by qualification.

Categories	Number teachers	Number of topics	Df	Mean	SD	t_{cal}	t_{tab}
Qualified teachers	9	20	38	0.75	1.09	3.311	2.025
Unqualified teachers	6	20	38	2.15	1.49		

The analysis in Table 1 shows that $t_{cal} = 3.311 > t_{tab}$, = 2.025. This indicates that there is significant different between the qualified teachers and the unqualified teachers as per the perceptions of levels of difficulty in mathematics syllabus. Hence the hypothesis 2 is rejected.

Hypothesis 3

There is no significant difference in the perceived level of difficulty of mathematics topics by male mathematics teachers and their female counterparts.

Table 2:- t-test summary table for perceived level of difficulty by male and female teachers

Categories	Number teachers	Number of topics	df	Mean	SD	t_{cal}	t_{tab}
Male teachers	11	20	38	1.8	1.57	1.7102	2.025
Female teachers	4	20	38	1.1	0.94		

From Table 2 it is indicated that the calculated value t_{cal} = 1.7102 is less than the table value t_{tab} = 2.025. This shows that there is no significant difference in the perceived level of difficulty of mathematics topics by male mathematics teachers and their female counterparts, the hypothesis was accepted. From this analysis it could be predicted that gender has no significant effect on the quality or effective performance of mathematics teachers.

Hypothesis 4

There is no significant difference in the perceived level of difficulty of mathematics topics by experienced mathematics teachers and less experienced ones.

Table 3:- Teachers experience on perceived level of difficulty in mathematics.

Categories	Number Teachers	Number of topics	Df	Mean	SD	t_{cal}	t_{tab}
Experienced teachers	12	20	38	0.7	1.01	3.28	2.025
Less experienced teachers	3	20	38	2.2	1.78		

Table 3 shows that $t_{cal}(3.28) > t_{tab}(2.025)$ which implies that the hypothesis is rejected. It means there is significant difference in the level of difficulty as perceived by experienced and less experienced teachers. This is an indication that experience of a teacher is a vital tool for effective teaching of mathematics.

Hypothesis 5

Male mathematics students are not significantly different from their female counterparts in their perceived levels of difficulty of mathematics topics.

The results obtained show that at 0.05 significant level, $X^2_{tab} = 30.14 > X^2_{cal} = 20.35$ and since the calculated value is less than the table value then the hypothesis was not rejected. Hence there is no significant difference in the perceived levels of difficulty of mathematics topics by male mathematics students and their female counterpart. This is an indication that gender has no implication on the perceived level of difficulty of mathematics topics.

Hypothesis 6

There is no significant difference in observed mean reasons for perceived levels of difficulty of mathematics topics by mathematics teachers and students.

Table 4:- Ranking of teachers reasons in ascending order

Teachers Reasons	Number	Mean
Poor knowledge of the subject matter(PK)	4	0.27
Wrongly deployment of teachers(WD)	6	0.38
Misconception of the contents(MC)	6	0.38
Low level of commitment(LLC)	12	0.80

Table 5:- The students' reasons ranked in ascending order

Teacher Reasons	Number	Mean
Wrongly deployment of teachers(WD)	28	0.16
Poor knowledge of the subject matter(PK)	43	0.24
Inability of students to express themselves(INE)	47	0.26
Low level of commitment(LLC)	81	0.45

Table 6:- Comparison of reasons by the teachers and students

Teachers Reasons	Students	Teachers
Poor knowledge of the subject matter(PK)	.16	0.27
Wrongly deployment of teachers(WD)	.24	0.38
Misconception of the contents(MC)	.26	0.38
Low level of commitment(LLC)	.45	0.80

It is shown in Tables 4, 5 & 6 that both teachers and students accepted low level of commitment on the part of teachers /un-care attitude of students as the major reason for perceived levels of difficulty in mathematics. Teachers ranked poor knowledge of subject matter (PK) as the least reason for perceiving a topic difficult to teach while students saw wrongly deployment of teachers as the least reason for perceiving a topic difficult to learn.

4. Conclusion

The main focus of this study was to examine the influence of teachers' qualification, experience and gender on the perceived levels of difficulty of mathematics topics. The findings of the study indicated significant difference in the perceived levels of difficulty of mathematics topics by qualified and unqualified teachers, experienced and less experienced teachers. This study showed that both teachers and students ranked Construction and Loci as having the highest level of difficulty. Also ranked difficult by teachers and students are: geometrical construction, statistics and probability, latitude and longitude, approximation and errors, measuration tables and formulae, algebraic expressions, plane geometry, quadratic equation, averages, trigonometry, surface area and volume, indices and logarithms, standard deviation, equations and inequalities, algebraic graphs, surd, fraction, decimal, number bases and percentage, set, simultaneous equation. The findings are in agreement with Obioma(1989) who discovered that some senior secondary school mathematics teachers perceived some topics difficult to teach and also in line with NERD(1993) report which identified 12 topics in mathematics have been perceived difficult.

It was also observed from the findings that the more qualified and experienced a teacher the better his performance in mathematics. This was in line with the finding of Unoroh (2004) who observed that the more

qualified and experienced a teacher the better his effectiveness in promoting and improving better students' academics performance. The findings of Oyedeji(1992) who worked on the influence of gender and teaching experience also corroborated the result which is also in agreement with Jones (1995) who pointed out that teacher with deeper understanding of mathematics tends to tailor their teaching to more conceptual views.

It has been stated that the students' performance in mathematics is poor despite the importance of the subjects in all human endeavours. The poor performance of learners in the subjects has led to the focus of the improving students' performance. This study has also contributed to the areas of the subject contents in sciences because almost all science subjects are mathematically based. It showed that teachers' qualification and experience influenced their perceived level of difficulty of mathematics topics. The more qualified and experienced the teachers are the less difficulty the mathematics topics and the more easy to teach.

The findings of this study revealed that gender had no influence on teachers and students view of level of difficulty in mathematics. It was observed from the findings of this research work that both the teachers and students identified their low level of commitment as the reason for the poor performance in mathematics. It was also noticed that teachers and students perceived 14 topics out of 20 topics investigated difficult to teach and learn. The implication of this is that the performance of students in the subject will continue to be low when the quality and commitment of the teacher handling the subject is low.

5. Recommendations

For science and technological education to advance in Nigeria, the following recommendations are made based on the findings of this study.

- Teachers should endeavour to improve themselves by acquire higher qualifications, attending mathematics workshops and seminars to update their knowledge.
- Curriculum developers should develop instructions that would improve students' knowledge in laying more emphasis on constructions in mathematics.
- Textbook writers should shift emphasis from teachers' activities to students' activities that will promote learning by doing.
- The school authorities should allocate more time and tutorial to students and also provide all materials necessary for construction in mathematics.
- State and Federal Government should motivate the teachers so as to be more committed.
- Appointment of teachers should be based on merit not whom you know.
- Mathematics educators should conduct more studies on perceived levels of difficulty of

mathematics topics for a decision to be taken across board.

Acknowledgement
The authors appreciate the support given by Deacon Aderinto, students, mathematics teachers and principals of the schools where the questionnaires were administered,

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