

ASSESSING AREAS OF STUDENTS' DIFFICULTIES IN THE LEARNING OF STATISTICS CONTENT IN SECONDARY SCHOOL MATHEMATICS CURRICULUM IN BAYELSA

by

Charles-Owaba, Tekenate

Department of Science Education Faculty of Education Rivers State University, Nkpolu-Oroworukwo, Port Harcourt. charlesowabat@gmail.com

Abstract

The study examined areas of students' difficulties in the learning of statistics content in secondary school mathematics curriculum. Descriptive survey design was adopted and the sample comprised of 639 SS3 Students in twelve Government owned secondary schools drawn from the eighth (8) educational zones of Bayelsa State. Four research questions and two research hypotheses were formulated to guide the study. The instrument was "Assessing Areas of Statistics Difficulties Questionnaires (AASDQ)" developed by the researcher and validated by two Lecturers in Science Education and one Lecturer in Measurement and Evaluation. The reliability of the research instrument, was established using Kuder-Richardson 21 formula and reliability co-efficient of 0.75 obtained was considered reasonable. Mean and standard deviation were statistical tools used for answering the research question while the hypotheses were tested using z-test at 0.05 level of significance. Findings revealed that secondary school students have perceived difficulties in statistics content. It was also revealed that lack of experienced mathematics teachers, non-completion of statistics content, deliberate skipping of statistical concepts, amongst others were the causes of difficulties associated with learning statistics content. Therefore, it was recommended that mathematics teachers should adopt varieties of instructional methods to teach statistics content.

Keywords: *Assessing, Student Difficulties, Statistics Content, Mathematics Curriculum.*

INTRODUCTION

Statistics is an indispensable tool for national development, growth and planning. It has played important role in the development of society from pre-historic era to the present and its role is still significant today and will still be significant in the future. Abel (2017) reported that a government which does not have a viable statistical infrastructure for information generation, dissemination and usage is severely handicapped, in its quest to do proper planning, monitoring and evaluation of developmental programmes, projects and in arriving at good decision with respect to policy formation. Olusegun and Olushina (2013) opined that the application of statistical knowledge has become imperative in virtually all areas of human endeavors; this is because decisions in many areas of modern society are based on the collection and analysis of empirical data. The overall goal of statistics at all level of learning is to develop skills necessary for conducting and interpreting research as well as evaluating media report in the form of graphs and/percentages.

In order to harness the potentials of statistics for National Development in Nigeria, statistics was first introduced as a school subject but later its elements were integrated into the curriculum of Mathematics and Further Mathematics. The teaching and learning of statistics starts from the primary school, where it is an integral part of the primary school mathematics curriculum. The first element of statistics is introduced in Primary IV under the heading "Everyday Statistics". The objectives at this early stage is to teach pupils how to;

- (i) Read pictograms and show information in pictograms using vertical and horizontal arrangements

- (ii) Identify the most common value from a pictogram.

In Primary V the pupils do further work on pictograms and bar graph. The objectives at this level are to teach the pupils how to read and draw bar graph. In Primary Six (VI) the everyday statistics component of the mathematics curriculum covers the following contents:

- (i) Further work on pictogram and bar graph.
- (ii) Preparing a tally and using it to make a table.
- (iii) The mode and mean.

At the end of this component of the National Primary School Mathematics Curriculum (2007), pupils are expected to be able to:

- a) Draw bar graphs and pictogram of information
- b) Prepare tables for graph work
- c) Calculate the mean data

At the secondary school, the elements of statistics are built into the mathematics and Further Mathematics curriculum. The statistical concepts taught at the Primary School are usually revised at the Junior Secondary School level and subsequently studied in greater details. In the senior secondary school level, the following topics are studied under statistics content as contained in the National Senior Secondary School Mathematics Curriculum (2007).

- Data Presentation: Tally
- Graphical Presentation of Data
- Group Data Presentation
- Measures of Central Tendency
- Measures of Spread for Grouped and Ungrouped Data
- Probability

Beyond the Secondary School level, statistics is taught in different forms. Tertiary Education in Nigeria takes different forms such as, Monotechnics, Polytechnics, Colleges of Education and Universities.

At the Colleges of Education, Mathematics is a teaching subject but statistics is not. Students, who major in Mathematics as a teaching subject, take some courses in statistics before they graduate (Ogum, 2008). At the University level, introductory statistics course is one of the requirements for an undergraduate degree in Education, Business, Engineering, Health and Social Science majors as well as a prerequisite for graduate school (Chew & Dillon, 2014). Introductory statistics course typically covers descriptive and inferential statistics approach (Pagano, 2012), which together provides a comprehensive understanding of the analytical process behind scholarly research (Ellah and Ita, 2017) and equip learners with skills for evaluating media report in form of graphs and percentage.

Polytechnics and Monotechnics offer statistics as a distinct discipline. Some other Polytechnics and Monotechnics offer statistics as part of mathematics programme. Apart from departments of statistics/mathematics, many other departments and faculties require their students to acquire some statistics courses at Ordinary National Diploma (OND) and Higher National Diploma (HND) programmes respectively.

Despite the Universal recognition of the numerous benefits of statistics and the subsequent step of making it a school subject, Olesugun et al. (2013) noted that the teaching and learning of statistics have not received much attention on how it could be improved. Ramon (2014) reported that statistics content is viewed as difficult and unpleasant and learners often see it as stressful and

anxiety-inducing burden. Charles-Ogan & Nechelem (2015) investigated difficult concepts in senior secondary school mathematics curriculum as perceived by students and identified geometry, bearing and distances, latitude and longitude, probability and statistics as difficult contents in the mathematics curriculum.

The report of the West African Examination Council (WAEC) Chief Examiner on mathematics content between 2008 and 2018 reveals that statistics have been an area of weakness consistently as shown in the table below;

Table 1: Chief Examiner's Comments on Statistics Content

YEAR	COMMENTS	
	WEAKNESS	STRENGTH
2008	✓	
2009	✓	
2010	✓	
2011		✓
2012	✓	
2013	✓	
2014	✓	
2015	✓	
2016	✓	
2017	✓	
2018	✓	

Source: WAEC Annual Report-Result Analysis

Many variables had been identified by Laurant (2018), Garfield (2012), Ramon (2014), as responsible for students' perceived difficulty in statistics content, such variables include; lack of basic mathematics skills, misconceptions of statistical facts, teaching method, anxiety, poor primary school background, large class syndrome, etc. Also, Olusegun et al (2013) citing Addichie (1991) identified factors militating against the teaching and learning of statistics as;

- (a) Reluctance on the part of educational authorities to recognize that statistics is a school subject distinct from mathematics.
- (b) Insufficient number of well-qualified statistics teachers at all levels.
- (c) Inadequate facilities in schools, colleges and universities.

Gender differences on students achievement in Mathematics is a major issue that has not produced conclusive results. So many researches on gender differences and students' achievement in Mathematics exist, but there is a scant empirical evidence on gender and statistics content only. Memeh (2006) researched on the influence of gender on the performance of Secondary School students in Mathematics and reported that males performed better than females in subject. Tui, Xu and Venator (2011) reported that at the elementary and middle school levels, the performance of girls were superior to that of boys in Mathematics. Observable gender differences that favour boys begin in secondary school on problem-solving tasks and these differences carry into performance on the Mathematics part of statistics done in the University (Tui, Xu and Venerator, 2011). This gender gap may be attributable to socio-cultural factors including the internalization of social stereotypes regarding male superiority in domains of mathematics that influence female performance (Saxon and Johnson, 2012). More specifically, females may be aware of negative stereotype threat that engenders a self-fulfilling prophecy in which female students acknowledge defeat before partaking in the statistics task, and thus succumb to the threat by performing worse on the assessment despite efforts to do well (Saxon et al., 2012). Alternatively, some suggest that weaker female performance in mathematical areas in which males perform well may relate to

females having poorer spatial-mechanical skills (Casey, Nuttal & Pererus, 2001). It is worthwhile to check how the gender argument will play out when only statistics content is involved.

School location refers to the environmental condition around a school, which could be urban or rural. Akiri (2008) summarized that, provision of education in rural areas is faced with difficulties and problems such as: qualified teachers, refusing appointments in isolated villages, lack of roads, books and teaching materials. School location and achievement in mathematics is a major factor that has not produced conclusive results. Onoyase (2015) researched into the influence of school location and students' academic achievement. The researcher found out that urban students performed better than their rural counterparts. Obe (2014) observed a significant difference in rural urban academic performance of 480 junior secondary school students in mathematics for Basic Common Entrance Examination (BECE). He concluded that children from urban schools were superior to their rural counterparts. Owoeye (2015) holds similar view that there was no significant difference between academic performance of students in rural and urban area in external examination. However, Ajayi and Ogunyemi (2013) and Gana (2016) in their different studies on the relationship between academic achievement and school location revealed that there was no significant difference between academic performance of students in urban and rural areas. Also, Naitain (2015) asserted that schools in the rural environments are in much more favourable positions for teaching mathematics and sciences, because of the availability of specimen and materials needed in teaching. She further asserted that there is a uniform level of cognitive achievement for urban and rural students. In respect to the above reports on the differences in achievement, based on school location, there is need for further investigation on school location issues as it relates to students' perceived areas of difficulties in statistics contents. The phrase "*area of difficulties*" refers to the aspect of something that is hard to deal with or understand. The phrase is not completely the inability of a student to obtain a pass mark in a collection of mathematics problem, but what constitutes "*a persistent hitch*" and makes procedural approach to cognition of a mathematics concept as a tedious task, all the time. In identifying learners' area of difficulties in statistical contents, Robertson and Wrights (2014) stated that students generally have intrinsic difficulty in mathematical reasoning, mathematics ideas and understanding basic mathematical concepts.

STATEMENT OF PROBLEM

Statistics plays a key role in shaping how individuals deal with the various spheres of life be it private, social or cooperate. Charles-Ogan and Nechelem (2015) reported that statistics as a small part of school mathematics curriculum has been afflicted by serious problems of poor performance in external examinations. The WAEC Chief Examiners report between 2008 and 2018 on mathematics content reveals that statistics has consistently been an area of weakness. This trend is frustrating to students' aspirations considering the role of statistics as an indispensable tool for national development. It is therefore necessary to allow students indicate what constituted their difficulties in the content area and the possible cause of such difficulties.

PURPOSE OF THE STUDY

The main purpose of the study is to examine areas of students' difficulties in the learning of statistics content of secondary school mathematics curriculum. Specifically, the study sought the following;

- 1) To determine specific aspects of statistics content, secondary school students' perceived as difficult to learn.

- 2) To identify the reasons for the students perceived difficulty.
- 3) To determine the relationship between areas of difficulty and gender.
- 4) To determine the relationship between areas of difficulty and school location.

RESEARCH QUESTIONS

The following research questions were formulated to guide the study;

- 1) What are the areas of statistics content students perceived difficult?
- 2) What are the reasons for the perceived difficulty?
- 3) What are the differences between male and female students' perceived areas of difficulties in learning of statistics?
- 4) What are the differences between urban and rural students' perceived areas of difficulties in learning of statistics?

RESEARCH HYPOTHESES

The following Research Hypotheses were formulated and tested at 0.05 levels of significance.

Ho₁: There is no significant difference between male and female students regarding their perceived areas of difficulties in secondary school statistics content.

Ho₂: There is no significant difference between urban and rural students regarding their perceived areas of difficulties in secondary school statistics content.

METHODOLOGY

RESEARCH DESIGN

This study adopted a descriptive survey research design. Descriptive survey research design, according to Lawrant (2018), is the one in which a group of people or item is studied by collecting analyzing data from only a few individuals or items considered to be representatives of the entire group. This design is appropriate for this study since information will be gathered from a sample of the population (SS3 students in Bayelsa), who are familiar with the ideas relating to the purpose of study with the aim of generalizing the results for the entire population.

POPULATION OF STUDY

The population of the study consisted of 3515 SS3 students in the 191 Government owned secondary schools located across the 8 educational zones of Bayelsa State. This choice of students was appropriate because they have learnt statistics and written internal examination on the content for the past five years.

Table 2: Distribution of Schools According to Senatorial District

Senatorial District	Local Government Areas	Number of Schools
Bayelsa West	Ekeremor	20
	Sagbama	24
Bayelsa East	Nembe	16
	Brass	10
	Ogbia	32
Bayelsa Central	Kolokuma/Opokuma	12
	Southern Ijaw	43
	Yenagoa	34
Total	8	191

Source: Bayelsa State Post Primary Schools Board, 2018.

SAMPLE AND SAMPLING TECHNIQUE

Stratified random sampling techniques based on the three senatorial districts in the state, was used to sample 3 out of the 8 Local Government Areas. Simple random sampling was used to select three (3) schools from each of the local government areas. The three (3) model schools in the local government areas of interest were purposively selected because they are the only urban schools in the local government areas of interest; making it a total of twelve (12) schools. All 639 Senior Secondary School 3 (SS3) students from the 12 schools formed the sample of the study.

Table 3: Sample Distribution of Schools

Local Government Area	Schools	Number of SS3 Students
Nembe	NNGS Ogbolomabiri	73
	CSS Oluwasiri	49
	CSS Okoroma	53
	CSS Agbakabiriya	41
Sagbama	GSS Sagbama	67
	CSS Tugbo	43
	CSS Agalabiri	40
	CSS Ofoni	39
Southern Ijaw	GSS Oporoma	69
	CSS Ogboinbiri	53
	CSS Korokorosei	61
	CSS Tebedaba	51
Total	12	639

Source: Bayelsa State Post Primary Schools Board, 2018.

Table 4: Distribution Of Students According to Sex

Schools	Sex		Number of SS3 Students
	Male	Female	
NNGS Ogbolomabiri	33	40	73
CSS Oluwasiri	22	27	49
CSS Okoroma	22	31	53
CSS Agbakabiriya	19	22	41
GSS Sagbama	30	37	67
CSS Tugbo	21	22	43
CSS Agalabiri	19	21	40
CSS Ofoni	20	19	39
GSS Oporoma	34	35	69
CSS Ogboinbiri	25	28	53
CSS Korokorosei	29	32	61
CSS Tebedaba	27	24	51
Total	301	338	639

Source: Bayelsa State Post Primary Schools Board, 2018.

Table 5: Distribution of Students According to Location

Location	Number of Schools	Number of SS3 Students
Rural	9	340
Urban	3	299
Total	12	639

Source: Bayelsa State Post Primary Schools Board, 2018.

INSTRUMENT FOR DATA COLLECTION

The instrument for data collection is a questionnaire developed by the researcher, tagged; “Assessing Areas of Statistics Difficulties Questionnaire (AASDQ)”. It consists of three (3) sections, namely; Section A, B and C. Section A measured the demographic variables of the respondents, Section B consist of a checklist of statistics topics drawn from the current National Mathematics Curriculum for Senior Secondary School. Respondents were asked to place each topic under one of the rating Very Difficult = 4, Difficult = 3, Less Difficult = 2 and Not Difficult = 1. Section C was made up of ten items on a 4-point Likert scale of Strongly Agree = 4, Agree =3, Disagree = 2 and Strongly Disagree = 1 of the reasons for any difficulty the respondents might have experienced.

VALIDITY AND RELIABILITY OF INSTRUMENT

The content and face validity of the instrument was done by one expert from measurement and evaluation and two others from Science Education Department, of Rivers State University, Port Harcourt. Their corrections and suggestions resulted to the final draft used in the study. The instrument was trial tested using forty (40) SS3 students that did not participate in the research but possess the same characteristics of the population of interest. The reliability co-efficient of 0.75 was obtained using Kuder-Richardson 21 formula which was considered appropriate for this study.

METHOD OF DATA ADMINISTRATION

The researcher administered questionnaire to the respondents during class with the assistance of the subject teachers. In all, 100% return rate was achieved.

DATA ANALYSIS

The data was analysed using mean and standard deviation for the research questions and z-test at 0.05 level of significance to test the research hypotheses. Any item with a mean value above 2.5 was not difficult (ND), while those 2.5 below was difficult (D).

RESULTS AND FINDINGS

Research Question 1

What topic of the statistics content do Secondary School Students perceive difficult?

Table 6: Students' Response on Areas of Difficulties in Statistics Contents

S/N	TOPICS	VD	D	LD	ND	Mean	Decision
1.	Collection, tabulation and presentation of data	0	0	307	332	2.80	ND
2.	Frequency Distribution	164	130	266	79	2.39	D
3.	Linear graph	51	110	217	261	2.78	ND
4.	Bar graph	105	158	363	3	2.32	D
5.	Pie Chart	105	133	391	10	2.24	D
6.	Frequency Polygon	87	125	258	169		

7.	Histogram	179	163	192	105	2.36	D
8.	Calculation of; <ul style="list-style-type: none"> ✓ Class boundaries ✓ Class mark ✓ Class interval 	49	146	255	189	2.43	D
9.	Drawing cumulative frequency curve	110	143	266	120	2.42	D
10.	Using cumulative frequency to estimate; <ul style="list-style-type: none"> ❖ Median ❖ Quartiles ❖ Percentiles ❖ Deciles 	128	107	256	148	2.23	D
11.	Determination of; <ul style="list-style-type: none"> ❖ Mean ❖ Median ❖ Mode from grouped data 	235	128	266	10	2.25	D
12.	Calculation of; <ul style="list-style-type: none"> ❖ Range ❖ Variance ❖ Standard Deviation ❖ Mean Deviation 	148	169	258	64	2.13	D
13.	Probability	266	309	51	13	2.30	D

The table above shows that topics of maximum difficulty include topics 2, 4, 5, 6, 7, 8, 9, 10, 11, 12 & 13. On the other hand topics like 1, 3 were observed to be least difficult of the statistics contents of Senior Secondary Mathematics Curriculum.

Research Question 2: What are the possible causes of the perceived difficulty?

Table 7: Causes of the Identified Difficult Topics in Statistics Content

S/N	ITEM	SA 4	A 3	D 2	SD 1	Mean	Decision
	Lack of experienced mathematics teacher in the school.	25 (100)	47 (141)	57 (114)	121 (121)	1.9	Disagree
	Non-completion of statistics scheme of work.	120 (480)	77 (231)	30 (60)	26 (26)	3.2	Agree
	Teacher's ability to relate statistical concepts to real live activities.	98 (392)	84 (252)	19 (38)	49 (49)	2.9	Agree
	Deliberate skipping of some statistical concepts.	130 (520)	74 (222)	34 (68)	22 (22)	3.3	Agree
	Poor background in Basic Mathematics at Secondary School Level.	93 (372)	78 (234)	79 (158)	-	3.1	Agree
	I have a belief that statistics is difficult.	119 (476)	72 (216)	39 (78)	20 (20)	3.2	Agree
	Available text books are not readable.	162 (648)	88 (264)	-	-	3.6	Agree
	The teacher has no confidence of himself during classes.	114 (456)	57 (171)	34 (68)	45 (45)	3.0	Agree

Table 2 above shows that Senior Secondary School students have knowledge of some of the factors that causes difficulties in the learning of Statistical Content. The result shows that the students agreed with items 2, 3, 4, 5, 6 7 & 8. The items they disagreed with were 1. This was based on the criterion mean of 2.5.

Research Question 3: Is there any difference between male and female student’s perceived difficulties in statistics content?

Table 8: Mean and Standard Deviation of Male and Female Students on Areas of Difficulties in Statistics Content

Gender	Number	Mean	Standard Deviation
Male	301	3.58	1.436
Female	338	3.45	1.038

The data above shows that mean response of male students is greater than that of female students on the areas of difficulties in the statistics content. Consequent upon the observed difference between male and female students the t-test was carried to ascertain if the difference is statistically.

Research Question 4: Is there any difference between urban and rural student’s perceived difficulties in statistics content?

Table 9: Mean and Standard Deviation of Urban and Rural Students on Areas of Difficulties in the Statistics Content

School Location	Number	Mean	Standard Deviation
Rural	340	3.23	1.506
Urban	299	3.46	1.643

The table above shows that, the mean scores of urban students on perceived area of difficulties is greater than that of rural students. Consequent upon this observed difference, the t-test was carried out to ascertain if the difference is statistically significant.

Research Hypothesis

Ho₁: There is no significant difference between male and female students perceived area of difficulties in statistics content.

Table 10: T-test analysis on the difference between male and female students’ perceived areas of difficulties in statistics content

Gender	Number	Mean	Standard Deviation	df	t-cal	t-crit	Decision
Male	301	3.58	1.436	637	1.794	1.960	NS
Female	338	3.45	1.038				

NS = Not significant at $p < 0.05$ alpha level; N = 250

The data presented in Table 6 shows that the calculated t-value of 1.794 is less than the critical value of 1.960 at 0.05 alpha level with 248 degree of freedom. Hence, the null hypothesis which states that, there is no significant difference between male and female students’ perceived areas of difficulties in statistics content is accepted.

Ho₂: There is no significant difference between urban and rural students perceived areas of difficulties in statistics content.

Table 11: T-test Analysis on the Difference between Urban and Rural Students’ Perceived Areas of Difficulties in Statistics Content

School Location	Number	Mean	Standard Deviation	df	t-cal	t-crit	Decision
Urban	299	3.23	1.506	637	1.884	1.960	NS
Rural	340	3.46	1.643				

NS = Not significant at $p < 0.05$ alpha level; $N = 250$

The data presented above indicates that, the calculated t-value of 1.884 is less than the critical value of 1.960 at 0.05 alpha level with 248 degree of freedom. Hence, the null hypothesis is accepted. This implies that, there is no significant difference between urban and rural students' perceived areas of difficulties in statistics content.

DISCUSSION OF RESULTS

The results reveal that students had difficulties in the following topics of the statistics content;

- ❖ Statistical representation
- ❖ Cumulative frequency curves
- ❖ Measures of Central Tendency
- ❖ Measures of Spread
- ❖ Probability

This implies that students' reasoning ability, problem solving and exposition to concepts in statistics is quite low. These findings is in agreement with that of Laurant (2018), Garfield (2012), Ramon (2014) who working independently, reported that statistics content is viewed as difficult and unpleasant.

The study identified lack of experienced teachers, non-completion of statistics scheme, teachers inability to relate statistical concepts to real live activities, students poor mathematics background, non-availability of readable textbooks, lack of confidence of teacher and student belief that statistics is difficult, as reasons for the cause of the perceived difficulties. This is in line with the findings of Charles-Ogan (2015), Abel (2017). Top on the list of causes were the issues of non-completion of statistics scheme and teachers inability to relate statistics content to real life activities. This finding supports earlier research by Olusengun et al. (2013) and Ogum (2008) who reported that statistics content were normally placed as the last topics in the scheme; which lead to the issue of non-completion.

The study reveals that there is no significant difference between male and female students' perceived areas of difficulties in statistics content. These findings is in agreement with the findings of Harbour-Peters (2001), Etukudo (2002), Memeh (2006) who reported that no significant difference between male and female students exist when assessing the way they view mathematics activities. On the other hand, the findings of this study are at variance with Ifamuyiwa (2007) who while analyzing the challenges learners encounter in mathematics, reported that males generally encounter less difficulties than their female counterparts.

Finally, the study revealed that there is no significant difference between urban and rural students' perceived areas of difficulties in statistics content. This implies that whether a student attends school in a rural or urban location, it does not make a difference in the perceived areas of difficulties he/she encounters while learning the statistics content of mathematics curriculum. This finding contradicts that of Owoeye (2015) and supports that of Ajayi et al. (2013) and Gana (2016).

CONCLUSION

Based on the findings of the study, it has been established that Secondary School Students have perceived difficulties in Statistics Content and the reasons for the perceived areas of difficulties have been identified.

It was also established that there is no difference between male and female Secondary School Students as well as those in Urban and Rural Schools as regards their perceived areas of difficulties in Statistics Content.

RECOMMENDATION

Based on the findings the following recommendation is drawn;

- (1) Mathematics teachers should adopt varieties of instructional methodology in the teaching of Statistics Content.
- (2) Workshops should be organized for mathematics teachers to be trained on how to effectively teach the identified difficult areas in statistics.
- (3) Mathematics teachers should abstain from topic skipping and endeavor to complete the scheme of work by relating the teaching of mathematics to students' daily activities via sufficient problem solving.

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