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Research Article

Improving the teaching and learning of Mathematics in secondary schools in Abia state using adequate statistical analysis

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Abstract

There is common knowledge that the wealth and development of any nation cannot be separated from her educational policies and strategies especially at the primary and secondary levels, as these provide a strong foundation and basic skill that will propel the pupils/students to have strong affinity and total embrace of the subject. Mathematics being the Chief host of most of the disciplines, needs a pride of place in the decisions, strategies, policies and fundamental issues of enacting laws in the education sector so as to make teaching and learning of the subject easy. In this work, we will be conducting some experiments to ascertain if there will be a significant difference in performance of Mathematics students who were taught using the conventional/traditional method of teaching as against using the (i) modern instructional aids and materials (ii) motivational lectures before the test/examination (iii) Computer systems, computer packages and tutorials, A pre-test and two post-tests is conducted on a randomly selected 50 students (25 males and 25 female), fifty (50) objective questions covering most of the SS3 Mathematics curriculum will be administered during the Pre – test and Post – test, and the results will be analysed. The stakeholders, which comprises of, students, parents, teachers and policy-makers in education sector shall respond to well-constructed questionnaires which target is to ascertain if the attitude of the stakeholders towards teaching and learning does not significant affect students' performance in Mathematics. We shall consider conducting a statistical test to ascertain if the secondary schools selected are not significantly consistent with each other over the introduction of the innovation in teaching. We expect that our findings shall be that the introduction of the new innovation as a method of teaching should improve the learning of Mathematics in our secondary schools.

Keywords: Mathematics, Secondary Schools, Statistical Analysis, Abia state

INTRODUCTION

Teaching and learning of Mathematics seems frustrating because it reflects the disappointments and inadequacies the stakeholders have felt for so long. The challenges that are faced by the students, teachers, parents and the government are quite enormous and it is glaring that the stakeholders are not proactive to these challenges.

Before it got to this abysmal level, the academic environment was very friendly, conducive to academic pursuit and encouraging to students. Teachers were interested in a holistic success for the students and parents were in the forefront of their children academic success. Students were focused and had high moral standard which was the pride and honourable virtue of every family; the level of corruption among students, teachers, parents and policy makers were minimal, insecurity in schools and society were considerably low, books, laboratories and instructional materials were available.

In this dispensation, students suffer from all manner of air and waterborne diseases, HIV, they go to school hungry, they lack modern mathematics textbooks and they are not literate enough in the area of Information and Communication

Technology (ICT) due to non- availability of computers and other related systems. The school Libraries and Instructional materials relating to the teaching and learning of Mathematics are not available.

Students learn in an unfriendly environment such as under trees and dilapidated buildings where there are no seats. It is obvious that teachers no longer have innate interest in students' academic growth as many have craved niches for survival as a result of not being well remunerated and long period of unpaid salaries and wages. More so, teachers aid and abate examination malpractices in order to gain money while some morally handicapped and corrupt parents connive with heads of schools and teachers to perpetrate examination malpractice.

It is observed that the students are afraid of Mathematics, either due to wrong information passed through elder ones, friends and peer groups or due to unnecessary pressure induced into the students through teachers' approach, emotions, knowledge of the subject and the fundamental principles of teaching through the use of instructional materials and assessment strategy (Fullan, 1991).

It is therefore necessary that our general resolve should be to revive the endangered quality of the education sector bearing in mind that Mathematics must be given a prominent consideration as a Chief host of many disciplines of human endeavour. In reviving the sector, the synergy and prudence of the stakeholders need not be overemphasized.

It is also observed that some students go for Mathematics examinations without formerly undergoing the various stages of acquiring the knowledge and skill as many enroll for the examination with the expectation of 'miracles' from 'kind' teachers or 'kind' students who will allow them to copy from others; this should be totally discouraged and culprits should be brought to book. It is therefore pertinent to define the National Policy on Education (NPE, 2004), Section 3 and it states as follows: "Basic Education shall be of 9-years duration comprising 6-years primary and 3-years of junior secondary school." "It shall be free and compulsory. It shall also include adult and non-formal education programmes at primary and junior secondary education levels for adults and out of school youths."

Basic education means early childhood care and education; the nine years of formal schooling, adult literacy and non-formal education, skill acquisition programmes and the education of special groups such as nomads, migrants, girl-child and women, Almajiri and disabled groups is meant to be free and compulsory. This nine year of universal basic education should therefore be a preparatory ground for every child that needs to be focused in the study and learning of mathematics.

To reduce school drop-out and improve relevance, quality and efficiency one should seek to acquire literacy, numeracy skills, provide mid-day meals to enhance access, retention and completion of school cycle, improve on routine curriculum diversification for relevance, efficiency and adequate coverage of practical/instructional tools for the advantage of the students during learning, individualize teaching methods, introduce rudiments of computer literacy, appropriate continuous teacher development, ensuring that stakeholders are included in decision making process in schools, infrastructural development, ensuring equity and gender equality, monitoring, assessment of students' performances routinely.

A wide variety of disciplines require students to have knowledge of Mathematics. Students of the biological sciences, finance, business and management are finding that they routinely need to perform calculations which require a firm understanding of basic ideas in algebra and calculus. Furthermore, some employers use standard Mathematics test as a screen for recruiting graduates regardless of their discipline. There is therefore need for the government to encourage authors of Mathematics to write understandable books and materials at a subsidized printing/publishing cost, ensuring that the books are not ambiguous, have clear pictures diagrams and tables for illustrations and teachers' approach that will be friendly to the learner (Janssen and Amoroso, 2017).

Development of student's mathematical skill by motivation

1. Increase the student's level of curiosity for the subject.
2. New ideas are built upon existing knowledge.
3. Learning Mathematics needs active participation such as working on all the homework assigned to the students.
4. Learning Mathematics through technology such as computer tutorials can be effective.
5. Learning to ask the teachers any step that is not well understood.
6. Identifying similarities among problems of Mathematics such as finding the similarity between Trigonometry and Algebra while solving a particular problem.
7. Re-practicing after every lesson, by setting the same problem done in a sheet of paper, re-do them again without referring to the one done in class.
8. Checking your errors after by comparing what you have done with the one done in the class and re-do it again if necessary.
9. Carrying out exercises on varieties of Mathematics problems can help build confidence and develop competence and expertise.
10. Group learning and practice of Mathematical problems can produce variety of ideas and solutions.

11. Figuring out the steps that pose a problem while solving a Mathematical problem.
12. One can use another piece of paper to make notes about a particular step that posed a problem during solving, but be very specific.
13. Do not miss out lessons since it is a booster to your further enquiry into the problem you will be about to study or solve.
14. If the topics are not well understood while the teacher was teaching, make out time to study it again so that you can be specific while asking your teacher for more explanations.
15. One might want to work on further problems which were not assigned as homework by trying his/her hands at problems in different Mathematics books as working extra problem is a good practice for many tests/Examinations.
16. Keeping a summary of the different kinds of problems one has worked on or of different methods that yielded the same result.
17. During your test or examination ensure that you give yourself a mock test by setting those questions you have been taught, practiced in the class, and as a home work to check how far you have fared by finding where you made mistakes as you compare with your notes and/or textbooks.
18. Do not be scared of the exercises in your textbooks or manuals and check how correct you are after solving, identifying the errors and ensuring the errors would not be committed again.
19. Do not abscond from test or examination.

Teaching strategy and development

1. Be adequately qualified as a teacher and in teaching Mathematics.
2. Create a friendly environment in your Mathematics class.
3. Make the students to participate actively by asking questions randomly.
4. Look at your students to know when they are not following.
5. Show a good example both in class and outside the class.
6. Be kind to listen to them when they ask questions concerning areas they did not understand either individually or as a group.
7. Do not make jest of them or bring them to ridicule when questions of obvious answers are asked.
8. Do not make them see Mathematics as a difficult task or make them see Mathematics as a subject meant for the teacher and their likes.
9. Give assignments to students, grade them and return the scripts to make them know and understand where they got it wrong.
10. Prepare your lesson notes and yourself for the lesson.
11. Use working or teaching materials/aids to assist you as you illustrate, it will also help the students to understand faster.
12. Use continuous assessment to test their skill and level of understanding of the topics treated.
13. Show equity and demonstrate equality of gender among all your students.

The role of Parents

1. Ensure you bring up your child to understand that Mathematics is important to him or her in spite of his/her discipline.
2. Ensure you know the type of friends your child keep and be in control.
3. Instill discipline and ensure that the habits of cultism and drug addiction are not in him/her.
4. Ensure you provide adequately to keep him/her focused.
5. Check out the performance of your child from time to time in that instance he or she would be alert to his or her studies since he/she knows you often check on the performance.
6. Enquire from the head of school or the teacher over your child's performance both in character and learning.
7. Students should be counseled by a guardian/counselor.
8. Do not encourage your child to get involved in examination malpractice.

The role of Government

All the government projects, policies and proposals towards achieving in education sector, particularly science-based areas and Mathematics are laudable; however, government should look into the following:
1. Pay teachers handsomely and on time

2. Provide scholarship for further studies and research both in local and international institutions to Mathematics students and for those who are majoring in Mathematics and Education.
3. Routinely check the standard of schools to ascertain the quality of teachers and administrators
4. Provide quality infrastructures for adequate study friendly environment
5. Make the study and teaching of Mathematics to be enticing so as to encourage as many as possible towards the subject which is the chief host of many disciplines.
6. Provide modern books, laboratories and other facilities to make teaching and learning of mathematics easy

STATEMENT OF PROBLEM

This research work will bring about introduction of teaching methods and techniques such as teaching aids, computer software, tutorials and motivational lectures that will enhance teaching and learning of Mathematics for students in Senior Secondary Schools in Abia State.

We shall construct questionnaires for the stakeholders such as the Parents, teachers, students and the Government to determine how their inadequacies affects teaching and learning of Mathematics, and what the stakeholders needs to do to improve teaching and learning of Mathematics.

We shall randomly select two local Government Areas of the state and from each of the randomly selected Local Government Areas; we shall randomly select two (2) secondary schools. We shall allow a period of two months for the conventional teaching with their usual teachers, after which we conduct a Pre-test on randomly selected 25 males and 25 females from each of the two (2) selected schools. After the pre-test, we shall embark on teaching the students by the researchers using teaching aids, computer assisted software and motivational lectures for a period of two (2) months, and thereafter we shall conduct two (2) post-tests on the selected students. We shall use the Chi-square test of independence to ascertain the dependence of teaching and learning on the attitude of the stakeholders. We will also test the consistency of the schools selected to know if there are differences among the sexes and schools using the pre – test and post – test scores to determine their performance in Mathematics as well as determine the difference between the conventional teaching and the innovational type as it affects learning of Mathematics using the Students t-test and the normal Z – test respectively.

The purpose of this research is to bridge the gap between the conventional method of teaching with little or no teaching aids, lack of computer software to ease leaning, motivation for teachers and students and to ensure that introduction of those innovations into teaching and learning of Mathematics is made a constant practice in school.

Our aim is to help the Government form an opinion and decisions to adopt these innovations so as to assist teachers and students in teaching and learning of Mathematics.

Justification

This research work is justified by the fact that the failure rate of senior secondary school students in Mathematics is quite very high, their performance in Mathematics in University matriculation examination is nothing to write home about and has significantly affected students who seek admission into higher institutions. Moreover, those admitted to study science and related courses have poor background in Mathematics and in the long run fail out of the program.

Some who seek jobs are often screened in Mathematics subjects and have always lost out. This therefore calls for research to see how we can improve performance in Mathematics through teaching and learning strategies: It has become a big challenge to the stakeholders especially the Government. The findings will to a large extent assist in making decisions that will help in teaching and learning of Mathematics.

Objectives of the project

The following are the objectives:
1. To analyse student's performance before and after the introduction of motivational lectures, teaching aids computer software packages to students and teachers.
2. To ascertain whether the performance of students in Mathematics depends on secondary schools selected.
3. To analyse the students' performance in relation to their sexes
4. To analyse the stakeholders' (students, teachers, parents and government) attitude towards improving the learning and teaching of Mathematics.

Research Hypothesis

1. There is no significant difference in mean scores of students using the modern practical teaching aids and materials and motivational lectures over the conventional traditional method of teaching.
2. The stakeholders' attitude to teaching and learning does not significantly affect students' performance in Mathematics.
3. There is no significant difference in mean scores of students among the schools selected over learning of Mathematics.
4. There is no significance difference in mean scores of the sex of students selected over learning mathematics.

Literature Review

The implementation of competency-based curriculum and its continuance implementation to the newest curriculum from Department of education which is lesson-based curriculum in high school becomes a challenge for Mathematics teachers, especially in an effort to improve the learning process and students' achievements. One of the efforts that need an attention is for the teachers to embrace to and improve students' achievement through innovation of teaching methods which should be in line with the materials being used which focuses on learning objectives as required by the curriculum. Innovation in education is very urgent especially in producing new teaching model that yield better learning result, escalate teaching efficiency and effectiveness. Innovation in education implies renewal in knowledge that originates from creative thinking, findings, and modification that contains ideas and method used to address education and learning process. Good learning process is a function of a communication tool in the delivery of course materials.

It often happens that a high school teacher is not equipped with improved teaching methods in the class room, most of them focus only on how to finish targets of the subject matter that are in the course syllabus in which the basic concepts of Mathematics is not completely relayed, it also makes the students get bored with the subject and the required knowledge that should be mastered by the students becomes difficult to learn. Teachers just rely on the curriculum as the guideline to finish their specific duty at a time, their only concern is about mastery and pro-founding of the lessons along with their experience in' their field (Sidabutar, 2016; Meier, 2018). So, in effect, teaching Mathematics in high school is not optimum (Odili, 2006). In order to optimize learning Mathematics in the class, teaching model for Mathematics should be effective and selective, which will be appropriate with the subject matter in improving the achievement of the students. So, every Mathematics teacher in the class should be alert about the lessons that he teaches in the class (Kendaga et al., 2021). Talanquer et al. (2003) opined that innovative teaching model is needed to improve students' achievement in Mathematics and that it may shift from formal learning to independent learning.

Kpee and Osiobe (2014) they opined that the recent threats to life and property experienced in Nigeria and so many other countries of the world have assumed an alarming dimension that the calls to fight against it has become necessary. They examined security challenges in Nigeria and their consequences on education institutions. They also critically examined the concept of natural security and they outlined and discussed various security challenges common to Nigeria as a nation. Their paper further prescribed various ways forward as it xrays different forms in which such challenges have affected education institutions. The paper recommends among others proscription of any form of terrorist act and imposition of consequences on sponsors and members of any sect that threatens the peace of the nation and security of its citizens.

Orikpe (2013) critically examined many security challenges bedeviling the nation. The paper is of the view that though Government has tried by increasing the budgetary allocation of funds to the security sector, it is still a far cry. The paper identified reform of the education system as a panacea to the lingering security challenges confronting the nation.

Deryn (2006) opined that there are a number of tensions and debates that have arose in the recruitment of the teacher, ICT and the future process in learning. He further stressed that in a deer context, it is possible to argue that too little attention has been paid to the act of teaching, and with widely available and different forms of information and knowledge, learners still need to learn and to think. He emphasized that teachers are the essentially need in ensuring this process of transformation and that their professional judgement and voice are essential in this process.

Baber (2011) opined that Mathematics is language of nature and plays dynamic role in human life, and so its learning is a compulsory part of curriculum from early childhood to secondary education in the entire world. He further stated that Mathematics originates from nature, it started with simple counting and these numbers adopted new forms with passage of time.

Saleem and Aqill (2006) described Mathematics as a deductive study of numbers, geometry and different dynamic constructs or structure. It is comprehensively divided into foundations, algebra, investigations and geometry which include hypothetical computer science.

Pound and Lee (2022) described Mathematics as an extension of reality. Noreen and Rana (2019) observed that students taught activity-based teaching performed better in post-test and they suggested that in future,

Mathematics may be taught with activities at elementary level.

Nesmith (2008) stressed the need to employ reform-oriented curricula to build upon constructivist perspectives that is aimed at assisting students in utilizing their own unique backgrounds and experiences to develop a personal understanding of Mathematical situations. One means of infusing personal experience into the Mathematics curriculum, while also bridging the aforementioned cultures, is through the corporation of children's literature, yet there exists great variance in the type, format, structure, and success of the methodology's implementation. Subsequently, while the reformative approach of Mathematics literature integration presents as a means of building understanding by bridging the culture of Mathematics and humanities, it is the educator's choices relevant to the approach which have the great impact on the outcomes of the approach.

METHODOLOGY

Population of Study

The population of Abia State constitutes the population of study.

Sample of Study

There will be random selection of local government areas from all the local government areas of the state. Further, we will randomly select two (2) secondary schools from each of the two selected local government areas.

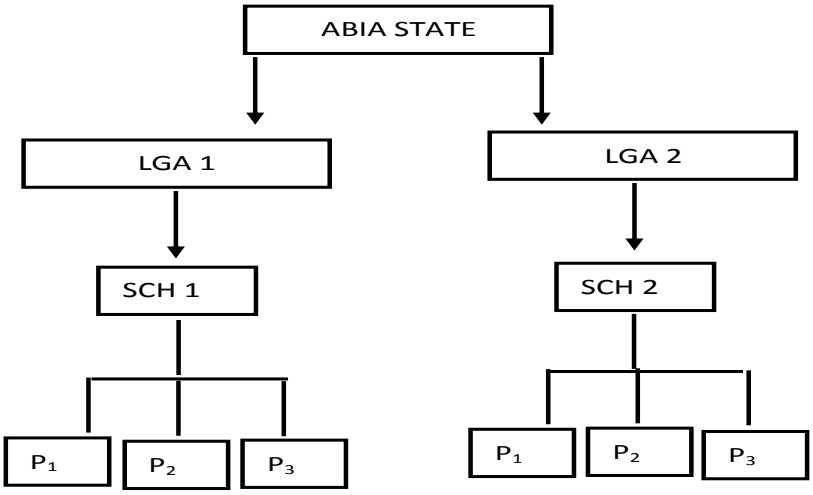

Figure 1. Structure for data collection
N/B: In Figure 1, P_1, P_2 and P_3 denotes the pre-test, first post-test and second post-test respectively.

Content of study

1. Administration of Mathematics examination for Senior Secondary Three (SS3) students from the various schools selected
2. For the stakeholders, we shall use questionnaires administered to 40 stakeholders from the location and community of the school.

Research Design

The research is experimented based on pre-test and two post-tests for control and group design.

Procedure for Data Collection

A pre-test and post-test will be conducted on randomly selected fifty (50) students (25 males and 25 females), 50 objective questions covering most of the Senior Secondary Three (SS3) mathematics curriculum will be administered during the pre-test and the post-test, and the results will be analyzed.

Questionnaires will be used to collect data on the stakeholders' attitude towards teaching and learning of Mathematics (20 students), (10 parents), (5 teachers) and (5 policy makers).

Method of Data Analysis

The t-test for paired samples the Z – Normal Test and the Chi-square test of independence will be used for analysis.

The t-test for paired sample

Let X_1 and X_2 denote the scores of students from pre-test and post-test. Then for n students, each score in the pair will be denoted by x_{ij}. The layout of data for the t-test is shown in Table 1.

Table 1: The layout of data for the t-test

Pre – test score X_1	Post – test score X_2
X_{11}	X_{21}
X_{12}	X_{22}
.	.
.	.
.	.
X_{1n}	X_{2n}

From Table 1, we form the difference between X_{1j} and X_{2j} and denote it by d_{ij}.
Thus

$$x_{11} - x_{21} = d_1, \;\; x_{12} - x_{22} = d_2 \;\; \ldots \;\; x_{1n} - x_{2n} = d_n$$

This sample difference has the mean

$$\bar{d} = \frac{\sum_{j=1}^{n} d_j}{n} \tag{1}$$

and the standard deviation

$$s_d = \sqrt{\frac{\sum_{j=1}^{n}\left(d_j - \bar{d}\right)^2}{n-1}} \tag{2}$$

The standard error of the mean difference shall be determined using the relation:

$$s_{\bar{d}} = \frac{s_d}{\sqrt{n}} \tag{3}$$

Our interest is to conduct a test of the following hypothesis

$$H_o: \mu_d = 0 \; versus \; H_o: \mu_d \neq 0 \tag{4}$$

The test statistic for this test is given by

$$t = \frac{\bar{d} - \mu_d}{s_{\bar{d}}} \tag{5}$$

The null hypothesis shall be rejected if $|t| > t_{\alpha/2,n-1}$ and accept if otherwise

The Chi-square test of independence

The Chi-square tests evaluates whether the observed frequencies in the various categories differ significantly from the frequencies that are expected under a specified set of assumptions. We shall adopt the chi-square test for independence, whose data layout is given in Table 2.

Table 2. Contingency table for test of independence

	Category 1	I	II	. . .	c	Row Total
Category 2	i	O_{11}	O_{12}	. . .	O_{1c}	R_1
	ii	O_{21}	O_{22}	. . .	O_{2c}	R_2
	.	.	.	.	.	.
	.	.	.	.	.	.
	.	.	.	.	.	.
	r	O_{r1}	O_{r2}	. . .	O_{rc}	R_r
	Column Total	C_1	C_2	. . .	C_c	N

From table 2, we shall determine the expected frequencies using the relation

$$E_{ij} = \frac{R_T \, x \, C_T}{N} \tag{6}$$

Where R_T is the row total, C_T is the column total and N is the grand total

The hypotheses to be tested are:
H_0: Levels of category 1 are independent of levels of category 2 (7)
H_1: Levels of category 1 are not independent of levels of category 2
The test statistics is given by

$$\mathcal{X}^2 = \sum_{j=1}^{c} \sum_{i=1}^{r} \frac{(O_{ij} - E_{ij})^2}{E_{ij}} \tag{8}$$

The null hypothesis shall be rejected if $\mathcal{X}^2 > \mathcal{X}^2_{\propto,(r-1)(c-1)}$. Otherwise it is accepted

EXPECTED OUTPUT/RESULTS

1. We expect that by introducing the modern innovation approach in teaching as against the traditional method of teaching, it will improve learning to a large extent.
2. The motivational lecture with students, parents and teachers will also improve the teaching, learning and parents' attitude towards ensuring successful outcome after test/examination.
3. We also expect that the improvement in teaching and learning will cut across the various schools under study and thus it can stand to generalize for the state and the nation at large.

Table 3. The pre-test and post – test 1 and post – test 2 scores from schools

Nos	Pre-test score	Post-test score 1	Post – test score 2
1.	32	34	38
2.	24	24	30
3.	30	42	46
4.	36	44	46
5.	40	50	54
6.	28	32	28
7.	44	46	48
8.	22	30	42
9.	50	58	62
10.	46	46	48
11.	38	36	40
12.	48	52	56
13.	28	32	42
14.	60	62	70
15.	42	40	42
16.	54	56	58
17.	26	30	42

Continuation: table 3

18.	26	28	38
19.	34	38	46
20.	32	40	48
21.	38	44	50
22.	36	40	52
23.	40	40	46
24.	22	20	26
25.	26	30	36
26.	48	52	58
27.	62	68	74
28.	20	26	30
29.	30	42	50
30.	28	40	50
31.	42	50	52
32.	66	64	66
33.	18	24	30
34.	30	40	46
35.	16	40	48
36.	26	32	34
37.	46	48	52
38.	52	50	54
39.	20	24	28
40.	44	56	60
41.	10	32	28
42.	22	40	42
43.	58	64	66
44.	64	68	66
45.	12	28	34
46.	38	46	48
47.	40	50	52
48.	68	74	72
49.	24	24	26
50.	18	22	30

HO: There is no difference in mean performance of the Pre-test and Post-test 1
HI: There is difference in mean performance of the Pre-test and Post-test 1

Normal distribution

Pre-test Score and Post – test Score 1

$$Z_{cal} = \frac{\bar{X}_1 - \bar{X}_2}{\sqrt{\frac{S_1^2}{n_1} + \frac{S_2^2}{n_2}}} \quad (9)$$

$Since\ \delta_2^1\ and\ \delta_2^1\ are\ unknown\ and\ n_1 and\ n_2\ are\ greather\ than\ 30\ i.e. n_1, n_2 > 30$

Let X_1 = Pre-test score and
X_2 = Post-test score 1

$$\bar{X}_1 = \frac{\sum X_1}{n_1} = \frac{32 + 24 + \cdots + 24 + 18}{50}$$

$$\bar{X}_1 = \frac{1804}{50} = 36.08$$

$$S_1^2 = \frac{\sum(X_1 - \bar{X}_1)^2}{50}$$

$$S_1^2 = \frac{(32-36.08)^2 + (24-36.08)^2 + \cdots + (24-36.08)^2 + (18-36.08)^2}{50}$$

$$S_1^2 = \frac{10391.68}{50} = 207.8336$$

$$\bar{X}_2 = \frac{2098}{50} = 41.96$$

$$S_2^2 = \frac{\sum(X_1 - \bar{X}_2)^2}{50}, n > 30$$

$$S_2^2 = \frac{(42-41.96)^2 + (40-41.96)^2 + \cdots + (26-41.96)^2 + (26-41-96)^2}{50}$$

$$S_2^2 = \frac{8747.92}{50} = 174.9584$$

$$Z_{cal} = \frac{36.08 - 41.96}{\sqrt{\frac{207.8336}{50} + \frac{174.9584}{50}}}$$

$$Z_{cal} = \frac{-5.88}{\sqrt{4.156672 + 3.499168}}$$

$$Z_{cal} = \frac{-5.88}{\sqrt{7.65584}}$$

$$Z_{cal} = \frac{-5.88}{2.7669} = -2.1251$$

$$Z_{\propto/2} = Z_{0.05/2} = Z_{0.025} = Z_{1-0.025} = Z_{0.975}$$

$$Z_{\propto/2} = Z_{tab} = 1.96$$

$$-Z_{\propto/2} = -1.96$$

Decision Rule: we shall reject H_o if $Z < -Z_{\propto/2}$ or $Z > Z_{\propto/2}$

Since Z_{cal} (= -2.1058) < -1.96, H_O is rejected and we therefore
Conclude that, there is difference in mean performance of the Pre-test and Post – test 1.

Analysis of Pre-test Score and Post – test Score 2

HO: There is no difference in mean performance of the Pre-test and Post-test 2
HI There is difference in mean performance of the Pre-test and Post-test 2
$\propto = 5\%$

$$Z_{cal} = \frac{\bar{X}_1 - \bar{X}_2}{\sqrt{\frac{S_1^2}{n_1} + \frac{S_2^2}{n_2}}}$$

X_2 = Post-test score 2

$$\bar{X}_1 = 36.08\,;\ S_1^2 = 207.8336, n_1 = 50$$

$$\bar{X}_2 = 46.6\,;\ S_2^2 = 156.52, n_2 = 50$$

$$Z_{cal} = \frac{36.08 - 46.6}{\sqrt{\frac{207.8336}{50} + \frac{156.5}{50}}}$$

$$Z_{cal} = \frac{-10.52}{\sqrt{4.156672 + 3.13}}$$

$$Z_{cal} = \frac{-10.52}{\sqrt{7.286672}}$$

$$Z_{cal} = \frac{-10.52}{2.6994} = -3.8972$$

$$-Z_{\propto/2} = -1.96$$

Since Z_{cal} (= -3.8972) < (-1.96}, H_O is rejected we therefore conclude that, there is difference in mean performance of the Pre-test and Post – test 2.

Table 4. Post 2 scores from the two schools

Nos	Post – Test 2 (School 1)	Post – Test 2 (School 2)
1.	38	54
2.	30	32
3.	46	38
4.	46	50
5.	54	46
6.	28	30
7.	48	52
8.	42	36
9.	62	58
10.	48	46
11.	40	52
12.	56	48
13.	42	48
14.	70	64
15.	42	46
16.	58	52
17.	42	38
18.	38	52
19.	46	50
20.	48	32
21.	50	48
22.	52	40
23.	46	50
24.	26	28
25.	36	38
26.	58	56
27.	74	64
28.	30	40
29.	50	46
30.	50	38
31.	52	58
32.	66	72
33.	30	32
34.	46	44
35.	48	52
36.	34	28
37.	52	48
38.	54	56
39.	28	26
40.	60	34
41.	28	36
42.	42	44
43.	66	60
44.	66	70
45.	34	38
46.	48	46
47.	52	48
48.	72	68
49.	26	30
50.	30	28

HYPOTHESIS TESTING

H_o: there is no significance difference in mean score of the two schools in Mathematics performance.
H_I: there is significance difference in mean score of the two schools in Mathematics performance.

Level of significance
$\propto = 0.05$

Test statistic is

$$Z_{cal} = \frac{\bar{X}_1 - \bar{X}_2}{\sqrt{\frac{S_1^2}{n_1} + \frac{S_2^2}{n_2}}}$$

$Since\ \delta_2^1\ and\ \delta_2^1\ are\ unknown\ and\ n_1, n_2 > 30$

Where, X_1 = Post Test 2 (School 1)

$$\bar{X}_1 = = \frac{\sum_{i=1}^{n_i} X_i}{n_1} \qquad \frac{\sum_{i=1}^{50} X_i}{50}$$

$$\bar{X}_1 = \frac{38 + 30 + \cdots + 26 + 30}{50}$$

$$\bar{X}_1 = \frac{2330}{50} = 46.6$$

$$S_1^2 = \frac{\sum_{i=1}^{n_i} (X_i - \bar{X}_1)^2}{50}$$

$$S_1^2 = \frac{(38 - 46.6)^2 + (30 - 46.6)^2 + \cdots + (26 - 46.6)^2 + (30 - 46.6)^2}{50}$$

$$S_1^2 = 156.52$$

Where, X_2 = Post Test 2 (School 2)

$$\bar{X}_2 = \frac{\sum_{j=1}^{n_2} X_j}{n_2} \qquad \frac{\sum_{j=1}^{50} X_j}{50}$$

$$\bar{X}_2 = \frac{54 + 32 + \cdots + 30 + 28}{50}$$

$$\bar{X}_2 = \frac{2290}{50} = 45.8$$

$$S_2^2 = \frac{\sum_{j=1}^{n_j} (X_j - \bar{X}_2)^2}{50}$$

$$S_2^2 = \frac{(56 - 45.8)^2 + (32 - 45.8)^2 + \cdots + (30 - 45.8)^2 + (28 - 45.8)^2}{50}$$

$$S_2^2 = 131.88$$

and n_1 and $n_2 = 50$

$$Z_{cal} = \frac{46.6 - 45.8}{\sqrt{\frac{156.52}{50} + \frac{131.88}{50}}}$$

$$Z_{cal} = \frac{0.8}{\sqrt{3.1304 + 2.6376}}$$

$$Z_{cal} = \frac{0.8}{\sqrt{5.768}} = \frac{0.8}{2.40177}$$

$$Z_{cal} = 0.3331$$

Decision Rule: we shall reject H_o if either $Z < -Z_{\propto/2}$ or $Z > Z_{\propto/2}$ we otherwise do not reject H_o

$$where\ Z_{\propto/2} = Z_{0.05/2} = Z_{0.025} = Z_{o.5-0.025} = Z_{0.4750} = 1.96\ (Half\ table)$$

$$Full\ table = Z_{1-0.025} = Z_{0.975} = 1.96$$

Conclusion: Since Z_{cal} (= 0.3331) < Z_{tab} (=1.96), H_O is not rejected
Therefore, we conclude that, there is no significance difference in mean score of the two schools in Mathematics performance

Table 5. Scores of male and female students selected randomly the two schools

Nos	Male post test score	Female post test score
1.	48	32
2.	62	24
3.	20	30
4.	30	36
5.	28	40
6.	12	28
7.	66	44
8.	18	22
9.	30	50
10.	16	46
11.	26	38
12.	46	48
13.	52	28
14.	20	60
15.	44	42
16.	10	54
17.	22	26
18.	58	26
19.	64	34
20.	12	32
21.	38	38
22.	40	36
23.	68	40
24.	24	22
25.	18	26

HO: There is no difference in mean performance of the two groups/sexes
HI: There is difference in mean performance of the two groups/sexes

Test statistics: students: t-test: $\propto = 0.05$

$$t_{cal} = \frac{\bar{X}_1 - \bar{X}_2}{S_p\sqrt{\frac{1}{n_1} + \frac{1}{n_2}}}$$

Let X_1 = male post test score
X_2 = female post test score

$$\bar{X}_1 = \frac{\sum_{i=1}^{n_1} X_i}{n_1} = \frac{48 + 62 + 20 + \cdots + 18}{25}$$

$$\bar{X}_1 = \frac{902}{25} = 36.08$$

$$S_1^2 = \frac{\sum_{i=1}^{n_1}(X_i - \bar{X})^2}{n_1 - 1} \quad ; n < 30$$

$$S_1^2 = \frac{(48 - 36.08)^2 + (62 - 36.08)^2 + (20 - 36.08)^2 + \cdots + (18 - 36.08)^2}{25 - 1}$$

$$S_1^2 = \frac{7875.84}{24} = 328.16$$

$$\bar{X}_1 = \frac{\sum_{j=1}^{n_2} X_j}{n_2} = \frac{902}{25} = 36.08$$

$$S_2^2 = \frac{2515.84}{24} = 104.8267$$

$$S_p^2 = \frac{(n_1 - 1)S_1^2 + (n_2 - 1)S_2^2}{n_1 + n_2 - 2}$$

$$S_p^2 = \frac{(25 - 1)328.16 + (25 - 1)104..8267}{25 + 25 - 2}$$

$$S_p^2 = 216.49335$$

$$S_p = \sqrt{S_p^2} = \sqrt{216.49335}$$

$$S_p = 14.7137$$

$$t_{cal} = \frac{36.08 - 36.08}{14.7137\sqrt{\frac{1}{25} + \frac{1}{25}}} = 0$$

$$t_{tab} = t\propto_{/2}, v = t_{0.05_{/2}}, 25 + 25 - 2$$

$$t_{tab} = t_{0.025}, 48 = t_{1-0.025}, 48$$

$$t_{tab} = t_{0..975}, 48 = 1.96$$

Since $t_{cal}(= 0.00) < t\propto_{/2}, v = (1.96)$. H_O is not rejected. We conclude that, there is no significance difference in mean performance of the two groups or sexes

Table 6: Stakeholder's attitude towards learning attitudinal grades/sexes

stakeholders	Intr. To computer	Motivation	Pro activeness	Use of modern books	Teaching aids	Cont, assessment
Parent attitude	5	3	4	3	6	8
Teachers Attitude	3	4	5	4	5	5
Students Attitude	3	4	3	3	4	4
Government Policies	6	3	2	4	3	4

Grades
0 – 2 (Poor)
3 – 5 (Fair)
6 – 8 (Good)
9 – 10 (Very Good)
H_0: The indices for learning is independent on the stakeholder attitude and policies
H_1: The indices for learning is not independent on the stakeholder attitude and policies
(α) Level of significance 5%; test Statistics $\mathcal{X}^2_{(r-1)(c-1),\propto}$

For Chi-Square Distribution

Table 7. Observed Values

						Total
5	3	4	3	6	8	29
3	4	5	4	5	5	26
3	4	3	3	4	4	21
6	3	2	4	3	4	22
17	14	14	14	18	21	98

Table 8: Expected Values

O_{ij}	e_{ij}	$\frac{(O_{ij} - e_{ij})^2}{e_{ij}}$
5	5.0306	0.0002
3	4.1429	0.3153
4	4.1429	0.0005
3	4.1429	0.3153
6	5.3265	0.0852
8	6.2143	0.5131
3	4.5102	0.5057
4	3.7143	0.0220
5	3.7143	0.4450
4	3.7143	0.0220
5	4.7755	0.0106

5	5.5714	0.0586
3	3.6429	0.1135
4	3.0000	0.3333
3	3.0000	0.0000
3	3.0000	0.0000
4	3.8571	0.00053
4	4.5000	0.0556
6	3.8163	1.2495
3	3.1429	0.0065
2	3.1 429	0.4156
4	3.1429	0.2337
3	4.0408	0.2681
4	4.7143	0.1082
		5.0828

$$e_{ij} = \frac{R_i x C_j}{n} = \frac{Row\ total\ x\ Column\ Total}{Grand\ Mean\ total}$$

$$\chi^2_{tab} = \sum_{i=1}^{r}\sum_{j=1}^{c}\frac{(O_{ij} - e_{ij})^2}{e_{ij}} = 5.0828$$

$$\chi^2_{tab} = \chi^2_{(r-1)(c-1),\ \alpha}$$

$$\chi^2_{tab} = \chi^2_{(4-1)(6-1),\ 0.05}$$

$$\chi^2_{tab} = \chi^2_{(3)(5),\ 0.05}^{\ 15}$$

$$\chi^2_{(1-0.05),15} = \chi^2_{0.95,15} = 25.00$$

Decision Rule: Reject H_o if $\chi^2_{cal} > \chi^2_{(r-1)(c-1),\ \alpha}\ or \chi^2_{cal} < -\chi^2_{(r-1)(c-1),\ \alpha}$.

Otherwise do not reject H_o

Decision

$$\chi^2_{cal}\ (= 5.0828) < \chi^2_{(r-1)(c-1)}(= 25.00).$$

Since H_o is not rejected, it concludes that, the indices for learning are independent on the stakeholder attitude and policies.

SUMMARY AND CONCLUSION

A random selection of two Local Government Areas of Abia State was done. We again randomly selected two secondary schools from each of the two selected Local Government areas. We finally selected out of the four selected secondary schools, two (2) secondary schools for the data collection and analysis.

A pre-test is conducted in the two schools; these pre-tests were done to find out the students' performance before the introduction of our research innovations, such as modern teaching aids, motivation, computer literacy and software packages.

The pretest is conduct on randomly selected 25 males and 25 females from each secondary school using 50 objective questions covering SS3 mathematics curriculum.

After the pretest and a two (2) months intensive teaching by the researchers two post-tests are conducted to the same selected students. The performance were graded over 100% Questionnaires were also given to the stakeholders in the educational sector as it pertains teaching and learning of mathematics. The stakeholders chosen are 20 students, 10 parents, 5 teachers and 5 policy makers. Each category of stakeholders' score were summed up and their mean score for each category obtained.

The normal Z-test of analysis at 5% level of significance was used for the test of difference in mean of the score between the pre-test and the post-test.

The normal Z-test analysis at 5% level of significance was used to test the difference in mean of scores between the two selected secondary school.

The student's t-test at 5% level of significance was used to test the difference in mean scores of the male and female students' performance in mathematics

The chi-square square X_2^2 dependence test was used to ascertain the level of dependence of the performance of students in mathematics on the attitude of the stakeholders at a 5% level of significance.

We came to conclusion based on our analysis as follows

(i) There is a significance difference due to the innovation of teaching methods, teaching aids, use of computer and its packages as well as motivation over the traditional method of teaching.

(ii) There is no significance difference among the males and females performance in Mathematics

(iii) There is no significance difference in performance of mathematics students among the two selected secondary schools

(iv) Teaching, learning and performance in mathematics has not in anyway been dependent on the stakeholders' interest and attitude

RECOMMENDATION

The students, teachers, parents and government officials should as a matter of necessity be proactive in the areas that could yield positive results in teaching and learning of mathematics.

We therefore recommend on the part of the government, employment of qualified mathematics teachers, training and retaining of teaching to acquire more knowledge and skill in the art of teaching mathematics.

Government should provide adequate learning environment such as classroom, laboratories, computer centres, libraries, recreational facilities and functional clinics to enable good learning and teaching of Mathematics. Government should serve as agents to monitor the management of schools, teacher and students, teacher should be well paid and on time.

Parents should inculcate a more reading and learning attitudes to their children/wards and should discourage their children in examination malpractice. They should instill discipline and keep their children away from bad influences of peer groups.

Teachers should be eager to get trained and learn new approaches to impart knowledge to students and they should be move friendly and motivational in their teaching practice.

Students should be made to get friendly in mathematics through motivation, scholarship sponsor, provision of modern books and their interest in computer knowledge skill and communication should be enhanced

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I am thankful to my students who due to their actions and sometime in-action in Mathematics that motivated this work. My gratitude goes to my family for their understanding and prayers during this research work.

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Department Of Mathematics
Federal Polytechnic, Nekede
Owerri.
3rd May, 2022

The Principal
Girls Secondary School
Umuocham
Aba.

Sir/Ma,

APPLICATION FOR THE USE OF YOUR SCHOOL FOR RESEARCH PURPOSE

I most respectfully apply to your office to permit me use your school as my research centre for a TETFUND Institution based research on “Improving the teaching and learning of Mathematics in Secondary Schools in Abia State.

The research will involve interacting with students and teachers. It will also involve teaching the students and getting responses from them as well as giving them test.

I am a staff of the Federal Polytechnic, Nekede, Owerri in the Department of Mathematics and statistics.

Thanking you immensely for your consideration and co-operation.

BASSEY O. ORIE

Department Of Mathematics
Federal Polytechnic, Nekede
Owerri.
3rd May, 2022

The Principal
Ututu Secondary School
Ututu, Archukwu, LGA
Abia State.

Sir/Ma
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BASSEY O. ORIE

STUDENT'S QUESTIONNAIRE

Kindly select an option amongst the five options (A-E). This questionnaire is mainly for research purpose; therefore any information given for the success of this research is highly confidential.

(1) Teachers of mathematics are friendly and motivational

(a) Agree ☐ (b) disagree ☐ (c) strongly agree ☐ (d)strongly disagree ☐ (e) fairly agree ☐

(2) The teachers are quite knowledgeable in the contents of mathematics curriculum
(a) Agree ☐ (b) disagree ☐ (c) strongly agree ☐ (d)strongly disagree ☐ (e) fairly agree ☐

(3) Teachers communicate with teaching aids to enhance learning
(a) Agree ☐ (b) disagree ☐ (c) strongly agree ☐ (d)strongly disagree ☐ e) fairly agree ☐

(4) Literacy in computer is used in learning mathematics by the teachers
(a) Agree ☐ (b) disagree ☐ (c) strongly agree ☐ (d)strongly disagree ☐ (e) fairly ☐

(5) The teachers impacts the knowledge of mathematics with a clear coherent communication
(a) Agree ☐ (b) disagree ☐ (c) strongly agree ☐ (d)strongly disagree ☐ (e) fairly agree ☐

(6) Modern understanding textbooks in mathematics are provided in our school for learning
(a) Agree ☐ (b) disagree ☐ (c) strongly agree ☐ (d)strongly disagree ☐ (e) fairly agree ☐

(7) There is provision of facilities such as laboratories, libraries, classrooms for teaching and learning
(a) Agree ☐ (b) disagree ☐ (c) strongly agree ☐ (d)strongly disagree ☐ (e) fairly agree ☐

(8) There are functional clinics and first aids facilities for students' health and welfare
(a) Agree ☐ (b) disagree ☐ (c) strongly agree ☐ (d)strongly disagree ☐ (e) fairly agree ☐

(9) Teachers gives homework and continuous assessment on weekly basis
(a) Agree ☐ (b) disagree ☐ (c) strongly agree ☐ (d)strongly disagree ☐ (e) fairly agree ☐

(10) Teachers mark and correct the assessment and return the script to the students for learning process
(a) Agree ☐ (b) disagree ☐ (c) strongly agree ☐ (d)strongly disagree ☐ (e) fairly agree ☐

TEACHER'S QUESTIONNAIRE

Kindly select an option amongst the five options (A-E). This questionnaire is mainly for research purpose; therefore any information given for the success of this research is highly confidential.

(1) Teachers are not motivated to teach due to the long owed salaries
(a) Agree ☐ (b) disagree ☐ (c) strongly agree ☐ (d)strongly disagree ☐ (e) fairly agree ☐

(2) Provision of basic teaching aids in schools are lacking
(a) Agree ☐ (b) disagree ☐ (c) strongly agree ☐ (d)strongly disagree ☐ (e) fairly agree ☐

(3) Some of the contents in the mathematics syllabus are not understood by teachers
(a) Agree ☐ (b) disagree ☐ (c) strongly agree ☐ (d)strongly disagree ☐ (e) fairly agree ☐

(4) Teachers are not computer literate to impact positively in learning mathematics
(a) Agree ☐ (b) disagree ☐ (c) strongly agree ☐ (d)strongly disagree ☐ (e) fairly agree ☐

(5) Teacher are not given scholarship for retraining in the area of mathematics
(a) Agree ☐ (b) disagree ☐ (c) strongly agree ☐ (d)strongly disagree ☐ (e) fairly agree ☐

(6) Preparation of lesson notes is usually a difficult task to teachers
(a) Agree ☐ (b) disagree ☐ (c) strongly agree ☐ (d)strongly disagree ☐ (e) fairly agree ☐

(7) Students are usually afraid of mathematics
(a) Agree ☐ (b) disagree ☐ (c) strongly agree ☐ (d)strongly disagree ☐ (e) fairly agree ☐

(8) Students are usually not confidence having their mathematics teachers in the class
(a) Agree ☐ (b) disagree ☐ (c) strongly agree ☐ (d)strongly disagree ☐ (e) fairly agree ☐

(9) Teachers of mathematics should be given an extra remuneration than other teachers
(a) Agree ☐ (b) disagree ☐ (c) strongly agree ☐ (d)strongly disagree ☐ (e) fairly agree ☐

(10) Teachers lack modern textbooks, periodicals and manuals to impact positively on the students.
(a) Agree ☐ (b) disagree ☐ (c) strongly agree ☐ (d)strongly disagree ☐ (e) fairly agree ☐

TEACHER'S QUESTIONNAIRE

Kindly select an option amongst the five options (A-E). This questionnaire is mainly for research purpose; therefore any information given for the success of this research is highly confidential.

(1) Employees are paid as at when due
(a) Agree ☐ (b) disagree ☐ (c) strongly agree ☐ (d)strongly disagree ☐ (e) fairly agree ☐

(2) Employees given scholarship for retaining 8% teachers
(a) Agree ☐ (b) disagree ☐ (c) strongly agree ☐ (d)strongly disagree ☐ (e) fairly agree ☐

(3) Government provides modern mathematics textbooks to ease teaching and learning
(a) Agree ☐ (b) disagree ☐ (c) strongly agree ☐ (d)strongly disagree ☐ (e) fairly agree ☐

(4) Government provides computer and its packages to teachers and students to ease
(a) Agree ☐ (b) disagree ☐ (c) strongly agree ☐ (d)strongly disagree ☐ (e) fairly agree ☐

(5) Government provides good learning environment such as classroom, laboratories and libraries
(a) Agree ☐ (b) disagree ☐ (c) strongly agree ☐ (d)strongly disagree ☐ (e) fairly agree ☐

(6) There is routine monitoring of schools, teacher and students by government officials
(a) Agree ☐ (b) disagree ☐ (c) strongly agree ☐ (d)strongly disagree ☐ (e) fairly agree ☐

(7) Government do provide recreational facilities for the relaxation of student
(a) Agree ☐ (b) disagree ☐ (c) strongly agree ☐ (d)strongly disagree ☐ (e) fairly agree ☐

(8) Government do provide health facilities and first aids to schools
(a) Agree ☐ (b) disagree ☐ (c) strongly agree ☐ (d)strongly disagree ☐ (e) fairly agree ☐

(9) Government do provide scholarship to students and teachers retaining as a way of motivation
(a) Agree ☐ (b) disagree ☐ (c) strongly agree ☐ (d)strongly disagree ☐ (e) fairly agree ☐

(10) The policies made by government to enhance teaching and learning of mathematics is adequate
(a) Agree ☐ (b) disagree ☐ (c) strongly agree ☐ (d)strongly disagree ☐ (e) fairly agree ☐

PARENTS QUESTIONNAIRES

Kindly select an option amongst the five options (A-E). This questionnaire is mainly for research purpose; therefore any information given for the success of this research is highly confidential.

(1) Mathematics is an essential subject which is the foundation of so many areas of life
(a) Agree ☐ (b) disagree ☐ (c) strongly agree ☐ (d)strongly disagree ☐ (e) fairly agree ☐

(2) Provision of modern textbooks for your child/children is essential in learning
(a) Agree ☐ (b) disagree ☐ (c) strongly agree ☐ (d)strongly disagree ☐ (e) fairly agree ☐

(3) Your level supervision or supervision of your child/ward is
(a) High ☐ (b) low ☐ (c) very high ☐ (d) very low ☐ (e) fair ☐

(4) Your level of communication with your child/ward
(a) Good ☐ (b) poor ☐ (c) very good ☐ (d) very poor ☐ (e) fair ☐

(5) your level of supervision of your child/ward's friends are peer groups is
(a) Good ☐ (b) poor ☐ (c) very good ☐ (d) very poor ☐ (e) fair ☐

(6) your interaction with the teacher and head of school over your child/wards performance in character and learning is
(a) Good ☐ (b) poor ☐ (c) very good ☐ (d) very poor ☐ (e) fair ☐

(7) your continuous inspection of your child's/ward's reports and continuous assessments is
(a) Good ☐ (b) poor ☐ (c) very good ☐ (d) very poor ☐ (e) fair ☐

(8) your attendance to parents teachers association (PTA) meetings is
(a) Good ☐ (b) poor ☐ (c) very good ☐ (d) very poor ☐ (e) fair ☐

(9) the impact of the PTA towards teaching and learning is good
(a) Agree ☐ (b) disagree ☐ (c) strongly agree ☐ (d)strongly disagree ☐ (e) fairly agree ☐

(10) your encourage general reading habits, learning and relearning of new technology and innovation as a family habit
(a) Agree ☐ (b) disagree ☐ (c) strongly agree ☐ (d)strongly disagree ☐ (e) fairly agree ☐