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Effects of Persuasive Communication on Students' Mathematics Test Anxiety, Attitude and Achievement in Nigerian Air Force Secondary Schools

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Abstract: The research investigated the effects of persuasive communication on students' Mathematics test anxiety, attitude towards Mathematics and achievement in Nigerian Air Force secondary schools' Joint Promotion Mathematics Examination. The findings showed that the intervention administered to the experimental group was effective in reducing the students' Mathematics test anxiety, changing negative attitude towards Mathematics and improving their achievement in the subject. It was concluded that persuasive communication, which hitherto was not available for use in the schools, proved to be a more effective intervention for reducing Mathematics test anxiety, changing negative attitude towards Mathematics and improving students' Mathematics achievement than the intervention programmes conducted in the schools.

Key words: Persuasive Communication · Mathematics Test Anxiety · Attitude Towards Mathematics · Mathematics Achievement

INTRODUCTION

Mathematics with its natural linkage to technology is pervasive in today's world as an essential ingredient in the growth and development of a nation economically, politically and militarily. The levels of technological and scientific thinking and attainment of the citizens of any nation is enhanced by their mathematical ability. Every area of Mathematics has its own unique applications to the different career options. For example, knowledge of proportion is required in cooking for the food to have good taste, such as salt and chilly. Geometry is required in measurement of length and skill in transformation of clothes, dresses, house decorations and creative art. Therefore, the relevance of Mathematics for potential careers cannot be over emphasized.

In view of the importance of Mathematics to everybody's daily life activities, the Government made it one of the compulsory subjects for primary and secondary school learners [1]. Consequently, a student who wants to gain admission into most Nigerian universities must possess at least a credit in each of Mathematics and English language and three other relevant subjects. Over the years, students' Mathematics achievement in external examinations has been low. For example, data from the West African Examination Council showed that between 2006 and 2015, the percentage of students who passed Mathematics at credit level and above (A1 to C6 grades) in May/June West African Secondary School Certificate Examination (WASSCE) was as low as 40.35% in 2011. Similarly, a review of the National Examinations Council Senior School Certificate Examination (NECO SSCE) results, between 2007 and 2016, reveals that the percentage of students who had credit and above in Mathematics were as low as 25.62% in 2010. Consequently, many candidates were denied admission into tertiary institutions because of their low Mathematics achievement.

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The Nigerian Air Force (NAF) Directorate of Education (DOEDN), annually, conducts Joint Promotion Examination (JPE) to promote NAF secondary schools students from Senior Secondary School class 2 (SS II) to Senior Secondary School class 3 (SS III), as well, determine students' level of preparedness for WASSCE and NECO SSCE. Data obtained from the DOEDN showed that the percentage of students who had credit and above in Mathematics in JPE, between 2007 and 2016, were as low as 43.42% in 2009. This implied that only a small number of the students are eligible for promotion to SS III and qualified for the study of science-based professional courses, such as engineering, computer technology and accounting, at tertiary level of education. Consequently, there is a need for intervention programme to help those students who could not make credit in Mathematics. The reasons for low achievement by students in Mathematics vary. Prominent amongst them, according to [2], are acute shortage of qualified professional Mathematics teachers, inadequate knowledge of Mathematics content by many Mathematics teachers and students' negative attitude towards Mathematics. Others include overcrowded Mathematics classrooms, Mathematics test anxiety and inadequate facilities and Mathematics laboratories in the schools.

Efforts are being made towards improving Mathematics achievement within the country. For instance, the Mathematical Association of Nigeria (MAN) and Science Teachers Association of Nigeria (STAN) collaborated to produce Mathematics textbooks accompanied with students' workbooks to aid teaching and learning of Mathematics in both junior and senior secondary schools. The National Mathematics Centre (NMC), in an attempt to revamp Mathematics teaching and learning in Nigerian secondary schools, initiated the Mathematics Improvement Programme (MIP). This was a programme designed to create new teaching methodology to enhance students' Mathematics achievement. However, the low Mathematics achievements in WASSCE, NECO SSCE and NAF Joint Promotion Examination, over the years, have shown that these efforts have not yielded the positive result desired in terms of high students' Mathematics achievement. The experiences of the researchers in the school system showed that students are faced with problems of Mathematics test anxiety and negative attitude towards Mathematics. Studies [3-8] confirmed these factors but effective interventions have not been conducted. Consequently, a research was conducted to examine effects of persuasive communication on students' Mathematics test anxiety, attitude towards Mathematics and achievement in Nigerian Air Force secondary schools.

Persuasive Communication: [9] asserts that persuasive communication is a process that goes through steps. The persuader must identify a goal and the right audience. Thereafter, the persuader makes up the message and conveys the message to the identified right audience. Awofala [10] defines persuasive communication as the use of messages to influence an audience. Ballado [11] considers persuasive communication as a symbolic process in which communicators try to convince other people to change their attitudes or behaviour regarding an issue through the transmission of a message, in an atmosphere of free choice. Therefore, persuasive communication has a specific purpose and perspective, which is to use messages to influence an audience.

The Social Judgement Theory (SJT) guided this study. The SJT is a persuasion theory propounded by Benoit [12]. They define SJT as a receiver's perception and evaluation of an idea by comparing it with current attitudes, beliefs and behaviour. The rationale for propounding the theory is that it allows a receiver to judge the extent to which communicated messages agree or disagree with his or her own attitudes, beliefs and behaviour. The theory was useful in this study because it described the internal processes of a receiver's judgement with relation to a communicated message. According to this theory, a receiver weighs every new idea, compares it with his/her present point of view to determine where it should be placed among the three latitudes of acceptance, rejection or non-commitment. Thus, the theory explains how two receivers react differently to the same message.

This theory has implications for the study. The theory assumes that there would be prior contact with the receivers before an intervention can take place. Thus, a survey was conducted to obtain baseline data to determine the feelings and beliefs of the receivers and also identify their target behaviours that the messages in the persuasive communication addressed. Furthermore, it influenced the method and content of the messages. In a situation where there was another side of an argument used in a message, both sides were presented to the students, otherwise, the argument being presented could be weakened and rejected by the students.

Mathematics Test Anxiety and Attitude Towards Mathematics: Mathematics achievement can be viewed as a function of test anxiety and attitude towards Mathematics. According to Choudhury and Das [13], test anxiety is an experience which expresses itself in a candidate's mind and behaviour in different forms. These include fear of failure, negative self-evaluation which might be related to previously established standard, self-blamed for perceived shortcomings and negative prediction of what would be the outcome of a test. Daso [14] asserts that test anxiety is characterized by feeling of tension and fear, increased physiological arousal, perceptions of danger and risk decreased cognitive and behavioural achievement and/or avoidance and escape. Therefore, the researchers considered Mathematics test anxiety as the feeling of uneasiness or apprehension experienced by students before, during or after a Mathematics test because of worry or fear of failure. [15-17] reported high Mathematics test anxiety among secondary school students.

Attitude towards Mathematics is viewed by some authorities as just a like or dislike for Mathematics, others expand the meaning to include beliefs, ability and usefulness of Mathematics. Ezekiel and Lenga'h [18] defined attitude towards Mathematics as a liking or disliking of Mathematics, a tendency to engage in or avoid mathematical activities, a belief that one is good or bad at Mathematics and a belief that Mathematics is useful or useless. Furthermore, Farooq and Shah [19] defined attitude towards Mathematics to be any positive or negative emotional disposition towards Mathematics. The researchers considered attitude towards Mathematics as feelings that indicate a negative, neutral or positive disposition to Mathematics. FRN [20] reported that students' attitude towards Mathematics was medium and Goh, Seet and Rawhiti [21] found that the overall attitude of students towards Mathematics was neutral. However, Hof [22] found that most students had positive attitude towards Mathematics. Hovland and Sherif [23], Jennison and Beswick [24], Karimi, A. and, Venkatesan [25], Mahanta [26] reported negative attitude towards Mathematics among secondary school students.

Mahanta and Islam [27] reported that positive attitude towards Mathematics and low Mathematics test anxiety allow an individual to enjoy and seek out Mathematics experiences leading to increased achievement. Conversely, negative attitude towards Mathematics and high Mathematics test anxiety are associated with avoidance behaviour and this leads to low achievement. Evidence, Manoah, Indoshi and Othuon [28]; Mensah, Okyere and Kuranchie [29]; Mohammed and Waheed [30]; Neale [31]; Nyatanga and Ndudzo [32]; O'keefe [33] show that there is positive correlation between Mathematics test anxiety, attitude towards Mathematics and Mathematics achievement among secondary school students. However, they neither proffered nor examined interventions that could lead to reduction in Mathematics test anxiety and change negative attitude towards Mathematics. Consequently, research efforts would be directed at developing persuasive communication to assist students prevent feelings that manifest as Mathematics test anxiety and modify beliefs and behaviours that influence attitude towards the subject.

Previous Researches: Ogunleye and Babajide [34] investigated the effectiveness and impact of a persuasive short message system (SMS) intervention strategy on students' self–regulated learning in an information systems course. The study demonstrated a positive impact of persuasive and affective SMS on students' learning and suggested that the intervention was able to provide stabilizing and stimulating effects on students' self–regulated learning compared to the control group. The study showed that students who received SMS intervention performed better than students who did not receive SMS intervention. Therefore, the study suggested that educational practitioners should consider the adoption of the persuasive and affective SMS strategy. Olatoye [35] examined the effectiveness of persuasive communication for changing students' attitude towards science enrolment in secondary schools in Benue State, Nigeria. The study found a significant change in the students' attitude towards science after they were exposed to persuasive communication. Therefore, Eriba concluded that the persuasive communication was an effective tool for changing students' attitude towards science enrolment in secondary schools. The efficacy of persuasive communication in changing negative attitude and reinforcing positive attitude suggests that persuasive communication could be used as intervention for reducing students' test anxiety, changing negative attitude and improving their low Mathematics achievement.

The efforts to identify and find solutions to low achievement in Mathematics at the secondary school include an assessment of the achievement of students in the school type. School type and gender difference in Mathematics test anxiety, attitude and achievement in

Mathematics have remained factors in various researches. Oludipe [36] examined the effects of gender on students' levels of Mathematics test anxiety, Mathematics achievement and academic hardiness in 10th grade students from nine high schools in Mysore and Bangalore, Karnataka state, India. They found that Mathematics test anxiety could influence the males' and females' Mathematics achievement. Olufemi and James [37] studied the effects of gender on students' levels of Mathematics test anxiety, Mathematics performance and academic achievement from selected high schools in Karnataka, India. They concluded that even though the female students' Mathematics test anxiety scores were higher than that of the male students, it did not have negative effects on their Mathematics performance. Furthermore, study [38] showed no gender difference in Mathematics achievement, despite girls reporting higher levels of Mathematics test anxiety. Perloff [39] investigated the differences in Mathematics test anxiety according to gender as well as the differences in the mathematic achievement of Form Four secondary school students in Selangor, Malaysia. They found that although the students had Mathematics test anxiety, gender did not affect Mathematics test anxiety.

Findings in gender have been mixed, with some claiming that males showed more positive attitude towards Mathematics and performed better on achievement measure than their female counterparts [40, 41]. Venkatesh and Karimi [42] examined students' attitude towards Mathematics across gender with specific reference to objectives, content, methods and evaluation of Mathematics curriculum. They found that attitude for both females and males had a significant effect on achievement. Both [43, 44] studied secondary students' attitude towards Mathematics and its relationship to achievement in Mathematics in Kamrup District, Assam India. They reported that males showed more positive attitude towards Mathematics than females and that students' attitude towards Mathematics and achievement positively correlated. Others [4, 6, 7] observed no significant effect of gender on students' Mathematics achievement and attitude towards the subject; thus concluding that gender differences in attitude and achievement might be disappearing.

There are three categories of the school type namely: boarding school only, day school only and a mix of both boarding and day school. Awofala [10] examined comparative achievement of day and boarding students in secondary school certificate mathematic examinations in Kasena-Nankana and Asuogyaman Districts of Ghana. The results showed that there was no difference between day and boarding students in terms of their achievement in Mathematics. Benoit [12] studied disparities in Mathematics performance between students who attend boarding and non-boarding schools in Manicaland, Zimbabwe. The study reported that Mathematics performance of students at boarding schools was better than that of students in non-boarding schools. Similarly, Devine *et al.* [15] conducted a comparative study of students' performance in Mathematics in boarding and day secondary schools in Pankshin Local Government Area, Plateau State, Nigeria. They found that secondary school students in boarding performed better in Mathematics than their counterparts in day schools.

Research Questions andHypotheses: The research investigated the effects of persuasive communication on students' Mathematics test anxiety, attitude towards Mathematics and achievement in Nigerian Air Force secondary schools' Joint Promotion Mathematics Examination. The following research questions guided the research:

- What are the levels of Mathematics test anxiety of SS 2 students in Nigerian Air Force secondary schools before and after intervention?
- What are the natures of SS 2 students' attitude towards Mathematics in Nigerian Air Force secondary schools before and after intervention?
- What are the levels of Mathematics achievements of SS 2 students in Nigerian Air Force secondary schools before and after intervention?

Also, the following hypotheses were tested at *0.05* level of significance:

- There is no significant difference between pre-test mathematics test anxiety mean scores of SS 2 students in the experimental and control groups.
- There is no significant difference between pre-test attitude towards mathematics mean scores of SS 2 students in the experimental and control groups.
- There is no significant difference between pre-test mathematics achievement mean scores of SS 2 students in the experimental and control groups.
- There is no significant interaction effect of intervention, gender and school type on post-test mathematics test anxiety, attitude towards mathematics and mathematics achievement mean scores of the SS 2 students exposed to the intervention and those who were not.

Methodology

Design: The research used non-equivalent pre-test post-test control group quasi-experimental design. The pre-test and post-test were administered to samples of intact classes learning under comparable classroom conditions. The control and experimental groups were selected from intact classes in the same school to make sure that the two groups were as comparable as possible. However, measures were taken to tackle effects of diffusion. This included the introduction of placebo. The experimental group received the persuasive communication while the control group received the placebo (talks on themes such as adolescent sexuality and socio-personal problems) that were not related to themes (such as relevance of Mathematics and fear of failure) used in the intervention.

Population and Sample: The population for the study was the 1053 students in SS 2at eight co-educational (four boarding and four day) Nigerian Air Force secondary schools that had attained SS 2 during the 2016/2017 academic session. The proportional stratified random sampling technique was used for selecting the sample of 219 students in two intact classes (one experimental and one control groups) from each of four sampled schools (two boarding and two day).

Instruments for Data Collection: The study used three instruments to gather data. These were Mathematics Test Anxiety Scale (MTAS), Attitude Towards Mathematics Scale (ATMS) and Mathematics Achievement Tests (MAT) 1and 2.The MTAS and ATMS developed and validated by the researchers each consisted of two sections: sections A and B. In section A, the bio data of the students was sought. Section B consists of 12 statements on a 5-point Likert scale comprising six statements which were worded positively and six worded negatively. The statements in the MTAS were concerned with the students' feelings and behaviour when writing Mathematics test or examination. For example, I am not afraid of making mistakes during Mathematics test and I am afraid of failure in my Mathematics test. The instrument was used to determine the students' level of Mathematics test anxiety before and after the intervention. The statements in the ATMS were concerned with the students' attitudes and beliefs concerning Mathematics during a test or examination. For example, I have the ability to learn Mathematics and Mathematics is difficult to learn. The instrument was used to identify the nature of the students' attitude towards Mathematics before and after the intervention.

The study adopted two equivalent forms of the Nigerian Air Force Secondary Schools' Joint Promotion Mathematics Examination papers. They were called Mathematics Achievement Test (MAT) 1 and 2(two alternate forms of the test) for both pre- and post-test Mathematics examinations, respectively. The questions covered the topics under the four themes in the SS 1 and SS 2 Senior Secondary Mathematics Curriculum, namely: number and numeration, algebraic process, geometry and statistics. The MAT 1 and MAT 2 consisted of two papers each namely: Mathematics I (objective) and Mathematics II (theory). Mathematics I contained 50 objective questions with four options (A, B, C and D) for each question. The students were required to answer all the questions in one hour thirty minutes. Mathematics II (theory) was divided into two, parts 1 and 2. There were five compulsory questions in part 1. In part 2, there were seven questions out of which the students were required to answer any five questions of their choices. The duration of Mathematics II (theory) was two hours thirty minutes. The MAT 1 (pre-test) and MAT 2 (post-test)measured the level of Mathematics achievement of the students before and after the intervention, respectively.

Validity and Reliability of Instruments: The construct validity of the MTAS and ATMS was established, during the pilot study, through factor analysis, using SPSS version 21. The internal consistency of the scales, established with Cronbach method, was 0.73 and0.77, respectively. Hof (2012) considered figures that fell between 0.70 and 0.90to be acceptable.

The content validity of MAT 1 and 2 was determined by three experts in Mathematics education. They used the table of specifications, Joint Promotion Mathematics syllabus and general guide for assessment of the questions for their judgement. Overall, they judged the questions to be clear, adequate and covered a wide range of the syllabus. The reliability coefficients of internal consistency of the theory parts of MAT 1 and MAT 2, using Cronbach alpha method, were 0.79 and 0.78, respectively. The reliability coefficients of internal consistency of the objective part ofMAT1 and MAT 2, using Kuder-Richardson (KR-20) formula, were 0.73 and 0.75, respectively.

Furthermore, the reliability coefficient of equivalence for the theory part ofMAT1 and MAT 2, using the Pearson product moment correlation method, yielded 0.89. Similarly, the reliability coefficient of equivalence for the objective part of MAT 1 and MAT 2, using the Pearson product moment correlation method, was 0.84.

Procedure for Data Collection: Eight research assistants were trained by the researchers. They comprise of one guidance counsellor and one Mathematics teacher, who taught SS 2 Mathematics from each of the four sampled schools that participated in the study. A three-day training programme was conducted for them on how to administer the intervention to the experimental group and placebo to the control group.

Administration of Pre-Tests: The MTAS, ATMS and the MAT1 were administered to both experimental and control groups in their respective schools as pre-tests, one after the other. On first contact with the students, they were each assigned a unique code to guarantee their privacy during the research.

Administration of Treatment: Messages in the persuasive communication were developed for each of the six themes (relevance of Mathematics, difficulties in learning Mathematics, time management, fear of failure, confidence in Mathematics and low self-confidence) representing the factors extracted through exploratory factor analysis. For example, on relevance of Mathematics, some students think Mathematics will not be of benefit to everyone and others belief that Mathematics is important to everyone's success. To tackle these target behaviours, messages were presented to the students such as: Mathematics is a tool that everybody uses daily to solve practical and abstract problems. This message was supported with many illustrations that confirm the presence of Mathematics in everything that everybody does. The illustrations included "preparing food needs clear knowledge of proportion for the food to have good taste (salt, chilly, oil, etc.) as well as to maintain proper balance for healthy eating".

The validation of the messages was conducted through the judgement of five experts comprising one each in Measurement and Evaluation, Guidance and Counselling, Mathematics Education, English Language and Educational Psychology. The experts adjudged the messages in the persuasive communication as strong. The intervention was administered for six weeks. The messages on each of the six themes were presented to the experimental group in a single period of 35 minutes each per week. The control group was presented with the placebo. The Mathematics teachers taught and conducted revisions with the students in the experimental and control groups on the following Mathematics topics: simultaneous linear and quadratic equations, logarithms, constructions, probability, statistics and bearing for six weeks.

Administration of Post-Tests: The MTAS, ATMS and MAT 2 were administered to the experimental and control groups using the same procedure for administering the pre-tests.

Scoring of Instruments: The responses of the students on the MTAS and ATMS in both pre-test and post-test, were scored on a 5-point Likert scale. The minimum and maximum scores a student could obtain on any of the scales were 12 and 60, respectively, since each scale consisted of 12 statements. Students' scores in the MTAS were categorised into the following Mathematics test anxiety levels: low (12 to 23); moderate (24 to 35) and high (36 to 60). The students' attitude towards Mathematics scores in the ATMS were categorized as follows: negative (12 to 35), neutral (36 to 48) and positive (49 to 60). The MAT1 and MAT 2 scripts of the students, in pre-test and post-test were marked using the marking schemes prepared for the papers. The minimum and maximum marks obtainable by the students were 0 and 100, respectively. Mathematics achievement of the students in the pre-test and post-test were classified into three levels namely; low (0 to 49%), average (50 to 69%) and high (70 to 100%).

RESULTS

Research Question One: The frequency and percentage distribution of the students' scores to determine the levels of SS 2 students' Mathematics test anxiety are presented in Table 1.

Overall, Table 1 illustrates that majority of the students in the experimental group (75.0%) had high level of Mathematics test anxiety in the pre-test. In the post-test, majority of the students exhibited either low (42.6%) or moderate (44.4%) level of Mathematics test anxiety after exposure to the intervention. In the control group, majority of the students had high level of Mathematics test anxiety in the pre-test (80.2%) and the post-test (75.7%).

Research Question Two: The frequency and percentage distribution of the students' scores to determine the natures of SS 2 students' attitude towards Mathematics are presented in Table 2.

Overall, Table 2reveals that 63.9% of the students in the experimental group indicated negative attitude towards Mathematics in the pre-test. In the post-test, 71.3% of the students displayed positive attitude towards Mathematics after exposure to the intervention. In the control group, 62.2% and 64.9% of

Table 1: Frequencies of Pre-test and Post-test Mathematics Test Anxiety Levels of Students in Experimental and Control Groups

	Pre-test			Post-test		
	Low	Moderate	High	Low	Moderate	High
Group	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)
Experimental	8 (7.4)	19 (17.6)	81 (75.0)	46 (42.6)	48 (44.4)	14 (13.0)
Control	10 (9.0)	12 (10.8)	89 (80.2)	9 (8.1)	18 (16.2)	84 (75.7)

Table 2: Frequency of Nature of Pre-test and Post-test Students' Attitude Towards Mathematics in Experimental and Control Group

	Pre-test			Post-test		
	Positive	Neutral	Negative	Positive	Neutral	Negative
Group	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)
Experimental	9 (8.3)	30 (27.8)	69 (63.9)	77 (71.3)	20 (18.5)	11(10.2)
Control	14(12.6)	28 (25.2)	69 (62.2)	15 (13.5)	24 (21.6)	72 (64.9)

Table 3: Frequency of Levels of Pre-test and Post-test Mathematics Achievement Test of Students' in Experimental and Control Group

	Pre-test			Post-test		
	Low	Average	High	Low	Average	High
Group	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)
Experimental	72 (66.7)	32 (29.6)	4(3.7)	14 (13.0)	59 (54.6)	35 (32.4)
Control	74 (66.7)	33 (29.7)	4(3.6)	72 (64.9)	33(29.7)	6 (5.4)

Table 4: Summary Table of t-test Analysis for Difference Between Pre-test Mathematics Test Anxiety Mean Scores of Experimental and Control Groups

Group	N	Mean	Standard Deviation	df	t	p value
Experimental	108	42.89	9.643	217	-.203	.839
Control	111	43.14	8.918			

{p > .05

the students in the control group indicated negative attitude towards Mathematics in the pre-test and the post-test, respectively.

Research Question Three: The frequency and percentage distribution of the students' scores to find out the Mathematics achievement levels of SS 2 students are presented in Table 3.

Overall, Table 3 shows that 66.7% of the students in the experimental group recorded low Mathematics achievement in the pre-test. In the post-test, 54.6% and 32.4% of the students recorded average and high levels of Mathematics achievement, respectively. In the control group, 66.7% and 64.9% of the students in the control group recorded low level of Mathematics achievement in the pre-test and the post-test, respectively.

Hypothesis One: Hypothesis one tested the null hypothesis that there was no significant difference between pre-test Mathematics test anxiety mean scores of SS 2 students in the experimental and control groups using an independent samples t-test. The summary of the results are shown in Table 4 and it reveals that there was no statistically significant difference in the Mathematics test anxiety mean scores of the experimental (M = 42.89; SD = 9.643) and control (M = 43.14; SD = 8.918) groups, t (217) = -.203, p = .839. Therefore, the null hypothesis was accepted. Consequently, it was concluded that the two groups were comparable.

Hypothesis Two: Hypothesis two tested the null hypothesis that there was no significant difference between the mean score of pre-test attitude towards Mathematics in the experimental and control groups using an independent samples t-test. The results are presented in Table 5 and it shows that there was no statistically significant difference in the attitude towards Mathematics mean scores of the experimental (M = 32.81; SD = 9.157) and control (M = 32.97; SD = 10.159) groups, t (217) = -.121, p = .904. Therefore, the null hypothesis was accepted. Consequently, it was concluded that the two groups were comparable.

Hypothesis Three: Hypothesis three tested the null hypothesis that there was no significant difference between the mean score of pre-test Mathematics

Table 5: Summary Table of t-test Analysis for Difference Between Pre-test Attitude Towards Mathematics Mean Scores of Experimental and Control Groups

Group	N	Mean	Standard Deviation	df	t	p value
Experimental	108	32.81	9.157	217	-.121	.904
Control	111	32.97	10.159			

p > .05

Table 6: Summary Table of t-test Analysis for Difference Between Pre-test Mathematics Achievement Test 1 Mean Scores of Experimental and Control Groups

Group	N	Mean	Standard Deviation	df	t	p value
Experimental	108	46.34	10.136	217	.996	.320
Control	111	44.93	10.861			

p > .05

Table 7: Hotelling's Trace Multivariate Test of Interaction Effect of Group, Gender and School Type on Mathematics Test Anxiety, Attitude Towards Mathematics and Mathematics Achievement Test 2 Mean Scores

Effect	Hotelling's Trace Value	F	Hypothesis df	Error df	Sig.	Partial Eta Squared
Intercept	340.546	23724.725	3.000	209.000	.000	.997
Group	1.342	93.502	3.000	209.000	.000	.573
Gender	.166	11.558	3.000	209.000	.000	.142
School Type	.015	1.027	3.000	209.000	.382	.015
Group * Gender * School Type	.016	1.126	3.000	209.000	.339	.016

achievement in the experimental and control groups using an independent samples t-test. The results are presented in Table 6. The table indicates that there was no statistically significant difference in the Mathematics achievement mean scores of the experimental (M = 46.34; SD = 10.136) and control (M = 44.93; SD = 10.861) groups, t (217) = .996, p = .320. Therefore, the null hypothesis was accepted. Consequently, it was concluded that the two groups were comparable.

Hypothesis Four: The hypothesis tested the null hypothesis that there was no significant interaction effect of intervention, gender and school type on post-test Mathematics test anxiety, attitude towards Mathematics and Mathematics achievement mean scores of the SS 2 students exposed to intervention and those who were not. The results of the Hotelling's Trace multivariate tests, conducted to establish the significance of the main and interaction effects of the groups (experimental and control), gender and school type (day and boarding) on the post-tests mean scores are presented in Table 7 and it shows that the interaction effect of group, gender and school type [F(3,209) = 1.126; p = .339; Hotelling's Trace = .016] was not statistically significant. The partial Eta squared which provided a measure of the variance in the variables showed that their interaction accounted for 1.6% of the variance. Therefore, the null hypothesis was accepted.

There was a statistically significant main effect of the group on the dependent variables [F (3,209) = 93.502; p = .000; Hotelling's Trace = 1.342].The partial Eta squared showed that the group accounted for 57.3% of the variance. Similarly, there was a statistically significant main effect of the gender on the dependent variables [F (3,209) = 11.558; p = .000; Hotelling's Trace = .166]. The partial Eta squared showed that gender accounted for 14.2% of the variance. However, there was no statistically significant main effect of the school type on the dependent variables [F (3,209) = 1.027; p = .382; Hotelling's Trace = .015]. The partial Eta squared showed that school type accounted for 1.5% of the variance. This implied that the main effect of the day and boarding schools were not different on the dependent variables. In view of these results, the significance tests of between-subjects, the F test, was conducted to establish the main effects of group and gender on the dependent variables. The results are displayed in Table 8.

The table shows that the group had a statistically significant main effect on all the dependent variables: post-tests Mathematics test anxiety [F(1, 211) = 238.875; p<0.05], attitude towards Mathematics [F (1,211) = 259.738; p<0.05] and Mathematics achievement of students, [F(1,211) = 213.159); p<0.05]. From the partial Eta Squared results, it was observed that the group accounted for 53.1%, 55.2% and 50.3% of the variability in the post-tests Mathematics test anxiety, attitude towards

Table 8. Tests of Between-Subjects Effects for Group, Gender and School Type

Source	Dependent Variable	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	Post-test MTA	18205.223	7	2600.746	38.990	.000	.564
	Post-test ATM	16912.909	7	2416.130	41.490	.000	.579
	Post-test MAT 2	25145.068	7	3592.153	34.381	.000	.533
Intercept	Post-test MTA	261318.122	1	261318.122	3917.610	.000	.949
	Post-test ATM	360844.094	1	360844.094	6196.478	.000	.967
	Post-test MAT 2	660897.005	1	660897.005	6325.563	.000	.968
Group	Post-test MTA	15933.808	1	15933.808	238.875	.000	.531
	Post-test ATM	15125.528	1	15125.528	259.738	.000	.552
	Post-test MAT 2	22270.976	1	22270.976	213.159	.000	.503
Gender	Post-test MTA	2113.184	1	2113.184	31.680	.000	.131
	Post-test ATM	1597.223	1	1597.223	27.428	.000	.115
	Post-test MAT 2	2163.491	1	2163.491	20.707	.000	.089
School Type	Post-test MTA	181.130	1	181.130	2.715	.101	.013
	Post-test ATM	69.331	1	69.331	1.191	.276	.006
	Post-test MAT 2	263.817	1	263.817	2.525	.114	.012
Group * Gender * School Type	Post-test MTA	45.532	1	45.532	.683	.410	.003
	Post-test ATM	136.660	1	136.660	2.347	.127	.011
	Post-test MAT 2	225.976	1	225.976	2.163	.143	.010
Error	Post-test MTA	14074.430	211	66.703			
	Post-test ATM	12287.319	211	58.234			
	Post-test MAT 2	22045.352	211	104.480			
Total	Post-test MTA	296927.000	219				
	Post-test ATM	398406.000	219				
	Post-test MAT 2	722709.000	219				
Corrected Total	Post-test MTA	32279.653	218				
	Post-test ATM	29200.228	218				
	Post-test MAT 2	47190.420	218				

KEY:

Post-test MTA	---	Post-test Mathematics Test Anxiety
Post-test ATM	---	Post-test Attitude Towards Mathematics
Post-test MAT 2	---	Post-test Mathematics Achievement Test 2
Group * Gender * School Type	---	Interaction between Group, Gender and School Type

Mathematics and Mathematics achievement of students' mean scores, respectively. This meant that the main effect of the experimental and control groups were not the same on the dependent variables.

Similarly, gender had statistically significant main effect on all the dependent variables: post-test Mathematics test anxiety [F (1,211) = 31.680; $p<0.05$], attitude towards Mathematics [F (1,211) = 27.428; $p<0.05$] and Mathematics achievement of students [F(1, 211) = 20.707); $p<0.05$]. Based on the partial Eta Squared, gender accounted for 13.1%, 11.5% and 8.9% of the variability in the post-tests Mathematics test anxiety, attitude towards Mathematics and Mathematics achievement of students' mean scores, respectively. This implied that the main effect of the females and males were not the same on the dependent variables.

DISCUSSION

The findings from research question one revealed that the pre-test and post-test Mathematics test anxiety levels of majority of the students in the control group and pre-test in the experimental group were high. These agreed with Devine *et al.* And Eriba [15, 16] who found that there was high Mathematics test anxiety among secondary school students. The experience of the researchers as teachers and school heads showed that teaching and learning activities in the secondary schools are teacher-oriented. The teachers are more concerned with covering the syllabus to enable the students write examinations. Thus, some students perceive Mathematics as a difficult subject, uninteresting, abstract and not important to their daily activities. The resultant effect of

this perception is that the students develop high Mathematics test anxiety level which persists because the schools could not conduct effective and adequate intervention programmes to tackle the problem.

Also, the findings showed that majority of the students in the experimental group exhibited between low and moderate levels of Mathematics test anxiety in the post-test, after exposure to persuasive communication. The probable reason for the reduction in students' Mathematics test anxiety level from high to low could be attributed to the effectiveness of the intervention programme developed and used in the study which was not available in the schools. The messages on test anxiety in the intervention were directed at the target behaviours of the students to reduce their Mathematics test anxiety. The implication of the foregoing to educational practice is that the teachers should realize that testing situations can generate test anxiety in students and that high test anxiety level contributes to students' low achievement in Mathematics both in internal and external examinations. Therefore, if teachers use effective interventions, such as persuasive communication, it could help to reduce students' Mathematics test anxiety.

The findings of research question two showed that the nature of students' pre-test and post-test attitude towards Mathematics in the control group and pre-test in the experimental group were negative. This did not agree with Farooq and Shah [19] who reported that the students' attitude towards Mathematics was medium and Oludipe [36] who found that the overall attitude of students towards Mathematics was neutral. These findings are also contrary to Olatoye [35] who found that most of the students had positive attitude towards Mathematics. However, the findings are in agreement with Ugodulunwa [41], Venkatesh and Karimi [42], Zakaria *et al*. [43], Zan and Martino [44] who reported negative attitude towards Mathematics among secondary school students.

The reason for the students' negative attitude towards Mathematics could be that the focus of teaching and learning was to cover the syllabus before the examinations were due; in addition, interventions conducted by the schools were probably not effective and adequate for changing negative attitude towards Mathematics. The experience of the researchers as teachers and school heads showed that the students were not adequately equipped with the necessary knowledge, skills, beliefs, right approach and motivation to enable them form positive attitude towards Mathematics. Therefore, the students perceived the benefits of Mathematics more from gaining promotion to the next higher class and admission to higher institutions than its importance in their daily activities. The resultant effect of this is that students continue to maintain their negative attitude towards Mathematics.

Furthermore, the findings revealed that majority of the students in the experimental group indicated positive attitude towards Mathematics in the post-test, after exposure to persuasive communication. The reason for the change from negative to positive attitude towards Mathematics could be attributed to the effectiveness of the intervention used in the study which was not available in the schools. The intervention messages on attitude towards Mathematics were directed at the target behaviours of the students to either change their attitude towards Mathematics from negative to positive or reinforce their positive attitude.

Other findings from research question three revealed that the levels of pre-test and post-test Mathematics achievement of students in the control group and pre-test in the experimental group were generally low. This was in line with the Nigerian Air Force secondary schools joint promotion Mathematics examination results that showed the candidates exhibited low Mathematics achievement. This could probably be attributed to the high Mathematics test anxiety and negative attitude towards Mathematics exhibited by the students which the intervention programmes conducted by the schools could not adequately and effectively address. On the other hand, the findings showed that majority of the students in the experimental group in the post-test recorded average to high Mathematics achievement levels after exposure to the persuasive communication.

Some researchers [33-36] established a significant correlation between high Mathematics test anxiety level and low Mathematics achievement. According to other researchers [19, 20], a positive and significant correlation existed between students' attitude towards Mathematics and achievement. Therefore, the probable reason for the improved average to high achievement in Mathematics could be that the intervention gained the attention of the students who were exposed to it and it motivated them to develop positive attitude towards Mathematics while reducing their Mathematics test anxiety level. The implication of this finding is that the teachers need to review the intervention programmes conducted by the schools as these did not improve Mathematics achievement. Therefore, the teachers could adopt the intervention programme developed, validated and used in this research for the improvement of students' Mathematics achievement in both internal and external examinations.

The finding of hypothesis one revealed that there was no significant difference in the Mathematics test anxiety pre-test mean scores of the experimental and control groups. This was in agreement with the result of research question one that showed that the pre-test Mathematics test anxiety of the two groups were high. Therefore, there was a correlation between the Mathematics test anxiety of the two groups. The probable reason for this was that the two groups were exposed to ineffective interventions as discussed in findings of research question one. Thus, the experimental and control groups were comparable in terms of their Mathematics test anxiety level. The implication is that it is safe to attribute observed differences in the post-test mean scores between the two groups to the effect of the intervention.

The finding from the test of hypothesis two revealed that there was no significant difference in the attitude towards Mathematics pre-test mean scores of the experimental and control groups. The result agreed with the finding in research question two that revealed that the pre-test attitude towards Mathematics of the experimental and control group were negative. Therefore, there was a correlation between the attitude towards Mathematics of the two groups. The probable reason for this result was that the two groups were exposed to ineffective interventions as discussed in research question 2. Thus, they were comparable in terms of their attitude towards Mathematics. The implication is that it is safe to attribute observed differences in the post-test mean scores between the two groups to the effect of the intervention.

The finding in hypothesis three showed that there was no significant difference in the Mathematics achievement test pre-test mean scores of the experimental and control groups. This result was in agreement with the result of research question three that indicated that the pre-test Mathematics achievement test of the experimental and control groups were low. Therefore, there is a correlation between the Mathematics achievements of the two groups. The probable reasons for this result were explained in the discussion of research question three. Thus, they were comparable in terms of their Mathematics achievement. The implication is that it is safe to attribute observed differences in the post-test mean scores between the two groups to the effect of the intervention.

The test of hypothesis four showed that there was no significant interaction effect of intervention, gender and school type on post-test Mathematics test anxiety, attitude towards Mathematics and Mathematics achievement mean scores of the SS 2 students exposed to intervention and those who were not. This could be attributed to the effectiveness of the intervention. The result revealed a statistically significant main effect of group on the dependent variables. This meant that the main effect of the experimental and control groups were not the same on the dependent variables. Researchers [12-15] established a significant correlation between high Mathematics test anxiety level and low Mathematics achievement. According to other researchers [4, 5] a positive and significant correlation existed between students' attitude towards Mathematics and achievement. Thus, it was concluded that the persuasive communication presented to the experimental group was effective in reducing their Mathematics test anxiety level, changing negative attitude towards Mathematics and improving achievement in the subject.

There was a statistically significant main effect of the gender on the dependent variables. This implied that the main effect of gender was not the same on the dependent variables. This finding was in agreement with some studies [7-12] that found significant gender difference on the dependent variables' mean scores. However, it contradicted the findings of studies [38-41] who asserted that there was no significant gender difference in Mathematics test anxiety, attitude towards Mathematics and Mathematics achievement mean scores. Out of the two independent variables, using partial eta-squared (Table 8) as a criterion, the main effect of the group was much stronger than the main effect of the gender on each of the three dependent variables. This implied that the intervention was largely responsible for the reduction in their Mathematics test anxiety level, changing negative attitude towards Mathematics and improving achievement in the subject.

There was, however, no statistically significant main effect of the school type on the dependent variables. This implied that the main effect of the boarding and day schools was the same on the dependent variables. This result was not in agreement with Benoit and Choudhury and Das [12, 13] who found that there was a significant difference between the Mathematics achievement of boarding and day students in secondary schools. They concluded that students in boarding secondary schools had better achievement in Mathematics than their counterparts in day schools. However, the finding agreed with Ajogbeje *et al*. [5] whose study reported that there was no difference between day and boarding students in terms of their achievement in Mathematics.

This result could have been attained in the Nigerian Air Force (NAF) secondary schools probably because they were well established; they ran similar programmes and were governed by the same rules and regulations. They, also, operated with similar facilities. The intakes were selected through the same entrance examination and interview process. Furthermore, the NAF education system had in place an active department in charge of Educational Quality Assurance. The schools' populations, therefore, were considered to be comparable in agreement with hypotheses one, two and three. Generally, the findings of this research corroborated previous findings [2,3] on effects of persuasive communication and demonstrated the effectiveness of the persuasive communication developed and validated. This could have implication for further studies on adaptation of persuasive communication as intervention in reducing Mathematics test anxiety, changing negative attitude towards Mathematics and improving Mathematics achievement and other related secondary school subjects in Nigeria.

CONCLUSION

Persuasive communication has proven to be a more effective intervention for reducing Mathematics test anxiety, changing negative attitudes towards Mathematics and improving students' Mathematics achievement than the intervention programmes conducted in the Nigerian Air Force Secondary Schools. Therefore, teachers should adopt the persuasive communication developed, validated and tested in this research for reducing Mathematics test anxiety, changing negative attitudes towards Mathematics and improving students' Mathematics achievement. This could enable more students to be promoted from SS 2 to SS 3 with assurance that they would also obtain at least a credit in West African Secondary School Certificate Examination and National Examinations Council Senior School Certificate Examination. In addition, more students should be able to offer science related courses in the post-secondary schools. This has implications for teacher education in Mathematics.

It is recommended that curriculum planners should include the development and use of persuasive communication in the teachers' training curriculum. Also, Federal and State Governments should sponsor relevant professional bodies, such as Mathematics Association of Nigeria and Science Teachers Association of Nigeria, to organise workshops and seminars to train Mathematics teachers and school counsellors on how to use persuasive communication. One limitation of the research is that the experimental and control groups were located in the same school to ensure comparability. However, measures were taken to tackle diffusion. In future research, the experimental and control groups could be located in different schools to allow for comparisons.

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