

Effects of Teacher Development Programme on Anxiety in Basic Arithmetic Operations among Pupils in Katsina State, Nigeria

¹Bawa, Muhammad Dahiru

¹Department of Mathematics
Isa Kaita College of Education
Dutsinma, Nigeria
Telephone: 07080298510

Abstract

This study was carried out to evaluate the effects of the in-service-teacher-development-programme on anxiety in basic arithmetic operations among pupils in Katsina state. The study adopted sample cross sectional survey design. This same study's sample size was 700 pupils comprising 358 and 342 male and female pupils respectively, selected from a population of 45,746 pupils in primary five from six Local Government Education Authorities (LGEAs) in Katsina Education Zone – three LGEAs participated in the program (ITDP), with 361 pupils, while the other three did not (Non-ITDP), with 312 pupils. Data was collected using the Abbreviated Mathematics Anxiety Scale (AMAS) – an instrument adapted from Ibrahim and Khatoon (2011) consisting of 30 items. AMAS was validated by experts in Psychology and Math Education. Following a pilot test, the reliability coefficients of AMAS was computed and found to be 0.802. Mann-Whitney U test was used to analyse the data. Findings showed that pupils from ITDP reported less anxiety compared to their counterparts from non-ITDP schools and the intervention's impact was gender balanced as male and female pupils were found to have similar anxiety levels within ITDP schools. Based on the study's findings, it was suggested that the state government consider replicating the program in LGEAs where it was not previously implemented. non-ITDP schools in control LGEAs need to start emulating strategies of the programme and professional bodies popularize strategies of the programme through a series of workshops and conferences.

Article History

Received: August, 2022
Review processes
September – October,
2022
Received in revised form:
November 2022
Accepted: November 2022
Published online:
December 2022

KEYWORDS

- In-service-teacher-development-programme
- ITDP
- Anxiety
- Gender

Introduction

Primary education is regarded as the most important as well as the most popular all over the world

(Lawrence, 2018). This level of education which serves as the foundation of the educational edifice is expected to provide literacy and enlightenment to citizens and it is the key to the system's success or failure. A careful examination of primary education goals reveals that mathematics is required for the majority of them to be met. Sample cut-off marks for admission into Federal Unity Schools for male and female candidates from Nigeria's six geopolitical zones in 2017 and 2018 revealed Katsina state as the least

and consistently below the national merit cut-off marks. Similarly, according to the results of a baseline line survey on Teacher Development Needs Assessment (TDNA) of Teacher Development Programme (TDP) phase 1 states (including Katsina) majority of students fell far short of curriculum expectations in numeracy De, Pettersson, Morris and Cameron (2016). It was not surprising that the same survey discovered that approximately 8% of teachers had sufficient professional knowledge of mathematics (scored 75% or higher) to be considered effective in the classroom when tested on topics covered by class 4 students. Though there are many factors that influence learning, the

quality and effectiveness of teachers are critical to learner success. Fortunately, Katsina State was included in the first phase of the UK Department for International Development's teacher training programme. The Programme was a six-year (2013–19) funded education program aimed at improving teaching quality in primary and junior secondary schools, Oxford Policy Management (OPM, 2017). The program was divided into two parts: pre-service and in-service. The goal of the in-service teacher development program (ITDP) component was to improve the ability of existing teachers to provide quality learning to pupils in primary schools in target areas. The in-service teacher-development component of the programme received approximately 80% of the programme's budget.

Ramirez, Chang, Maloney, Levine and Beilock (2015) observed that even at a young age, children report having math anxiety, which has a negative impact on their math achievement. Brooks (2020) saw math anxiety a feeling of tension and anxiety that interferes with the manipulation of numbers and the solving of mathematical problems in ... ordinary life and academic situations. Mathematics anxiety is a crippling negative emotional reaction to mathematics. Again, Garba, Ismail, Osman and Rustam (2020) revealed that mathematics anxiety is prevalent in Nigeria where students have a fear of the subject and their study found that peers' speech and behaviour can intensify or minimize mathematics anxiety. According to research findings on mathematics anxiety, it is associated more with female learners at different levels of educational pursuit. Hannake, Tamara,

Schleepen and Van den Berg (2019) in a study on 'Gender Differences Regarding the Impact of Math Anxiety on Arithmetic Performance reported that although boys and girls showed more or less equal levels of math anxiety and performed similarly, correlation analyses revealed that only in females was math anxiety significantly correlated with math performance. Females have higher rates of anxiety at all ages, with the difference becoming slightly more pronounced at the post-secondary school level, though this may be due to females being more willing to admit to feelings of anxiety. Other studies found no gender differences in anxiety levels, possibly due to changing societal attitudes toward girls and mathematics.

Habineza (2019) discovered no significant gender difference in mathematics anxiety; there was no discernible difference in attitude and anxiety toward mathematics based on school status (Government, Government-aided, and Self-financed secondary schools); there was a significant difference between government and privately funded secondary schools (boarding schools, non-boarding schools, and technical schools Vocational Education and Training). Zhou and Liu (2020) investigated the effects of teacher–student rapport on urban and rural students' math learning in China and discovered that, when compared to rural students, mathematics self-efficacy, mathematical academic outcome, and significantly lower mean scores for mathematics anxiety were reported by urban students; teacher-student rapport had a significant effect on reducing students' mathematics anxiety in both urban and rural schools; however, teacher-student rapport in rural schools

increased rural students' mathematics anxiety. Mubark (2021) conducted a study to look into the experiences of rural high school students with mathematics anxiety in academic settings, and the findings revealed that at some point in their academic careers, all students experience mathematics anxiety, frequently, or always.

Statement of the Problem

Anxiety about mathematics has long been a source of concern in education community that can have far-reaching consequences as primary school children who are anxious about mathematics are a critical group who are more likely to underachieve in the subject. Many people carry their anxiety into adulthood, limiting their career opportunities and passing on their fears to their children. If young children in primary school begin to feel anxious about mathematics, it may be possible to implement measures to counteract this development before they develop entrenched attitudes about mathematics and their own mathematical ability. The conduct of in-service teacher development programme (ITDP) in Katsina State from 2013 to 2019 was perhaps an effective means of improving students' mathematics self-efficacy and helped in reducing mathematics anxiety. This research effort was motivated by the desire to assess the effects of gender and location on pupils' anxiety in mathematics in Katsina State following the conduct of In-service-Teacher-Development-Programme. The study intended to establish whether the conduct of the professional development programme had closed or widened gaps in learners' anxiety based on gender and location in LGEAs

the programme was carried out. Objectives for carrying out the study are listed below.

Objectives

The following objectives guided the research:

1. To ascertain if a difference exists in pupils' anxiety levels in basic arithmetic operations between ITDP and Non-ITDP schools in Katsina state.
2. Find out the effects of gender on anxiety in mathematics of pupils' taught by teachers who participated in in-service-teacher-development-programme in Katsina state.

Research Questions

The study posed the following questions for answers:

1. Does mathematics anxiety levels differ among pupils' in basic arithmetic operations between ITDP and Non-ITDP schools in Katsina state?
2. Are there differences in the anxiety levels in mathematics between male and female pupils taught by teachers who participated in in-service-teacher-development-programme in Katsina state?

Null Hypotheses

For testing at $p \leq 0.05$, the following null hypotheses were developed.

- Ho₁: There is no significant difference in mathematics anxiety levels of pupils taught by teachers in ITDP and Non-ITDP schools in Katsina state.
- Ho₂: There is no significant gender difference in mathematics anxiety levels of pupils taught by teachers who participated ITDP in Katsina state.

Methodology

The study adopted a sample cross-sectional survey design, and the population of this study comprises 45,746 primary five pupils from six Local Government Education Authorities (LGEAs) in Katsina Education Zone – three LGEAs participated in the programme (ITDP), involving 361 students, while the other three did not (Non-ITDP) with 312 pupils. The study's sample was 700 pupils comprising 358 and 342 male and female pupils. Abbreviated Mathematics Anxiety Scale (AMAS) – an instrument adapted from Ibrahim and Khatoon (2011) consisting of 30 items was used to collect data. Experts in psychology and mathematics education validated AMAS. Following a pilot test, the

reliability of AMAS was determined by single administration and Cronbach's alpha (1951) was computed and found to be 0.802. Mann-Whitney U test was used to analyse the data using Statistical Package for Social Sciences (SPSS) version 20.

Results

The study's findings derived from answering research questions and testing hypotheses through the analysis of 361 out of 380 questionnaires that were returned.

Research Question 1: Does mathematics anxiety levels differ in basic arithmetic operations between ITDP and Non-ITDP schools in Katsina state

Table 1: Anxiety Mean Rank for ITDP and Non-ITDP Groups

Group	N	Mean Rank	Sum of Ranks	Mean Rank Diff.
ITDP	361	238.00	74256.50	184.56
Non-ITDP	312	422.56	152544.50	
Total	673	660.56	226801.00	

Table 4.1 reveals that pupils taught by teachers exposed to in-service-teacher-development-programme expressed less anxiety towards mathematics in comparison to pupils taught by teachers in Non-ITDP schools. From the table, anxiety mean rank for pupils in ITDP group is 238.00 compared to pupils in the Non-ITDP group whose anxiety mean rank is 422.56. The mean difference is 184.56. To determine the difference's statistical significance, Mann-Whitney U test was used to test the first null hypothesis.

Null Hypothesis One

There is no significant difference between the mean anxiety levels in mathematics of pupils taught by teachers in ITDP and Non-ITDP Schools in Katsina state.

To test this hypothesis, summated anxiety scores of pupils from ITDP and Non-ITDP schools were compared using Mann-Whitney U test statistic. Table 2 displays summary of the results.

Table 4.2: Mann-Whitney U Test on Anxiety Levels of ITDP and Non-ITDP Groups

Group	N	Mean Rank	Sum of Ranks	Mann-Whitney U	Z-Value	P-Value	Effect Size (d)
ITDP	361	238.00	74256.50	30503.500	-11.644	0.000	0.841
Non-ITDP	312	422.56	152544.50				
Total	673	658.77	226801.00				

Table 4.2 reveals the anxiety level of students whose teachers took part in an in-service teacher development programme was significantly lower than that of pupils taught by teachers who did not participate in in-service-teacher-development-programme. The observed Mann-Whitney U value is 30503.500 with a Z-value of -11.978 and the P-value of 0.000 ($p < 0.05$). As a result, the null hypothesis was rejected, and it was concluded that teachers' participation in in-service-teacher-development-programme significantly reduced pupils' anxiety towards mathematics in ITDP schools in Katsina state. Moreover, the

effect size of the difference between the means of pupils taught by teachers in ITDP and Non-ITDP groups was 0.841 which suggested there was a large effect size between pupils' anxiety levels in ITDP and non-ITDP schools using Cohen (1988) criteria.

To examine descriptive statistics of male and female pupils regarding the effects of in-service-teacher-development-programme on pupils' anxiety in mathematics among treatment schools, anxiety mean ranks for male and female pupils were computed and compared as indicated in Table 4.3

Table 4.3: Anxiety Mean Ranks of Male and Female Pupils in ITDP Group

Group	N	Mean Rank	Sum of Ranks	Mean Rank Diff.
Male	186	178.12	33130.00	-5.94
Female	175	184.06	32211.00	
Total	361	362.18	65341.00	

Table 4.3 shows the variation between the mean ranks of male and female pupils in the ITDP group. Female pupils had a relatively higher mean rank towards mathematics compared to males. The mean difference is 5.94. However, to establish whether the mean rank difference is statistically significant, the Mann-Whitney U test statistic for independent samples was used to test null hypothesis four.

Null Hypothesis Two

There is no significant difference between the mean anxiety levels in mathematics of male and female pupils taught by teachers who had in-service-teacher-development-programme in Katsina state.

To test this hypothesis, anxiety scores of male and female primary five pupils in the ITDP group were compared using the Mann-Whitney U test statistic for

independent samples. Table 4.4 presented a summary of the analysis.

Table 4.4: Mann-Whitney U Test on Anxiety Levels of Male and Female Pupils in ITDP Group

Gender	N	Mean Rank	Sum of Ranks	Mann-Whitney U	Z-value	p-value	Effect Size (d)
Male	186	178.12	33130.00	15739.500	-0.625	0.532	0.057
Female	175	184.06	32211.00				
Total	361	362.18	65341.00				

Table 4.4 reveals that male and female pupils whose teachers participated in the in-service-teacher-development-programme did not differ significantly in their anxiety levels towards mathematics. The Mann-Whitney U value obtained in the test was 15739.000 with a z-value of -0.625. The p-value observed in the test was 0.532 ($P > 0.05$). This result did not provide sufficient evidence for rejecting the null hypothesis. The null hypothesis was therefore retained, and it was concluded that participation of teachers in in-service-teacher-development-programme was gender neutral regarding pupils' anxiety towards mathematics in ITDP primary schools. Moreover, the effect size of the gender difference in pupil means is 0.057 which suggested there was a trivial effect size between pupils' anxiety levels using the criteria by Cohen (1988).

Discussion

The analysis's findings relating to null hypothesis three revealed that there was a statistically significant difference in the anxiety levels of pupils taught by teachers in ITDP schools when compared with their counterparts in Non-ITDP schools in Katsina state. That means the

programme had positive effects in treatment schools of the study area as pupils from those schools exhibited less anxiety. This outcome tallies with the finding of Middendorf (2018) who carried out a study on the effects of teaching math study skills on the retention of math concepts, math anxiety and math cognition to High School geometry students with a specific learning disability and reported that implementing math study skills correlated with math cognition and decreased math anxiety. Also, Schaeffer, Rozek, Berowitz, Levine and Beilock (2018) in a study on 'Disassociating the Relation between Parents' Math Anxiety and Children's Math Achievement: Long-Term Effects of a Math Application Intervention' reported that access to an educational math application that 1st-grade children and parents used together improved this relation. Again, Garba, Ismail, Osman and Mohd-Rameli (2020) conducted a study on 'Exploring Peer Effect on Mathematics Anxiety among Secondary School Students in Sokoto State, Nigeria Using a Photo Voice Approach' and discovered that negative peer behaviour, such as poor students causing trouble and the use of

frightening and discouraging statements in mathematics classrooms, as well as intelligent students dominating the lesson, has a direct effect on increasing mathematics anxiety. However, Positive peer behavior, such as group discussions and positive advice, was found to reduce mathematics anxiety.

However, in sharp contrast with this finding, Batton (2010) in a quasi-experimental quantitative study which investigated 'The Effectiveness of Cooperative Groups on The Math Anxiety Levels of Grade 5 Male and Female Students' that involved thirty-two students from 2 Grade 5 classrooms who were administered the pre and post MASC inventory and used repeated-measure ANOVA to compare the overall mean difference for each group reported that males in the treatment group showed no change in math anxiety levels when compared to males in the control group. Also, Spaniol (2017) did a study on 'Math Performance and Academic Anxiety Forms, from Socio-Demographic to Cognitive Aspects: A Meta-Analysis' which employed causal-comparative, a correlational study that involved 32 developmental math and 32 college students who were chosen to create equal group sizes for data analyses using independent samples t-test found no significant differences in self-efficacy or anxiety between groups.

The result of the analysis regarding null hypothesis two revealed there was no significant difference between the anxiety levels of male and female pupils taught by teachers in ITDP schools in Katsina state. The finding showed that the in-service-teacher-development programme had no

discriminative influence on pupils' anxiety levels. This finding did not support the findings of Hannake, Tamara, Schleepen and Van den Berg (2019) who conducted a study on 'Gender Differences in the Impact of Math Anxiety on Second and Fourth Grade Arithmetic Performance' involving 124 second- and fourth-grade children (67 girls and 57 boys) and reported that despite the fact that boys and girls had similar levels of math anxiety and performed similarly on arithmetic tasks, an investigation into whether math anxiety moderated the effect of gender and grade on math performance revealed significant differences between boys and girls.. Also, Asikhia (2021) in a study on 'Gender Differences in Mathematics Anxiety among Secondary School Students in Nigeria's Ogun West Senatorial District' reported a significant difference on the effect of gender on students' mathematics anxiety. The study also revealed higher mathematics anxiety levels for male students than females.

However, this finding in part supports Hannake, Tamara, Schleepen and Van den Berg (2019) who studied 'Gender Differences in Relation to Math Anxiety in Second and Fourth Graders' that involved 124 second and fourth grade children (67 girls and 57 boys) and found that boys and girls had similar levels of math anxiety and performed similarly on arithmetic tasks. Corroborating the finding of this study, Gholami, Mohd-Ayub, Yunus and Kamarudin (2021) after the conduct of a study on the 'Impact of Lesson Study (LS) on Mathematics Anxiety and Mathematics Achievement of Malaysian Foundation Programme Students' reported there was no statistically significant interaction

between the effects of educational method and gender on both mathematics anxiety and achievement.

Conclusion

The findings of the study showed that pupils taught by teachers who participated in in-service teacher development exhibited less mathematics anxiety in comparison to their counterparts from Non-ITDP schools and the effect of the intervention programme on gender was symmetrical. Recommendations

In light of the study's findings, the following recommendations were made:

1. The Katsina state government needs to sustain the programme in all treatment LGEAs and extend the intervention into control LGEAs that were not involved *ab. initio*.
2. Effective teaching of mathematics requires competent and experienced teachers, as such state government and LGEAs are required to employ, retain, and incentivize such teachers.
3. Professional bodies like Mathematical Association of Nigeria (MAN) and institutions-based journal ought to promote approaches of ITDP in conferences, workshops, and publication in their journals.

References

Asikhia, O. A. (2021). Gender Effect on Mathematics Anxiety of Secondary School Students in Ogun West Senatorial District, Nigeria in Asian Journal of Education and Social Studies, vol. (15) 4: 17 - 23 @ <https://journalajess.com/index.php/A>

[JESS/article/view/30386](https://www.zarjes.com/JESS/article/view/30386), accessed on 28/06/21

Batton, M. (2010). The effect of cooperative groups on math anxiety. *Walden Dissertations and Doctoral Studies*. 822 @ <https://scholarworks.waldenu.edu/dissertations/822>, accessed on 21/11/21

Brooks, E. (2020). @ <https://www.cne.psychol.cam.ac.uk/what-is-mathematics-anxiety> , accessed on 13/11/21

De, S. Pettersson, G.; Morris, R. & Cameron, S. (2016). Teacher Development Programme (T.D.P) Impact Evaluation of Output 1: In-Service Training, Education Data, Research and Evaluation in Nigeria (EDOREN) @ <https://reliefweb.int/report/nigeria/independent-report> accessed on 12/11/18

Garba, A.; Ismail, N.; Osman, S. & Rameli, M. R. M. (2020). Exploring Peer Effect on Mathematics Anxiety among Secondary School Students of Sokoto State, Nigeria through Photovoice Approach in *EURASIA Journal of Mathematics, Science and Technology Education*, vol. (16) 2 Article1815 @ <https://eric.ed.gov/?id=EJ1265117>, accessed on 21/12/21

Gholami, H.; Mohd-Ayub, A. F.; Mohd-Yunus, A. S. & Kamarudin, N. (2021). Impact of lesson study on mathematics anxiety and mathematics achievement of Malaysian foundation programme students in International Journal of Evaluation and Research in Education (IJERE), Vol. 3: pp. 912 - 920 @ <http://ijere.iaescore.com>, accessed on 12/01/22

- Habineza, F. (2019). Students' differences on attitude and anxiety towards mathematics by gender and schools' status @ <http://www.ijern.com/journal/2019/July-2019/11.pdf>, accessed on 23/03/22
- Hanneke, I. V. M.; Tamara, M. J. S. & Fabian, C. G. V. (2019). Gender Differences Regarding the Impact of Math Anxiety on Arithmetic Performance in Second and Fourth Graders @ <https://doi.org/10.3389/fpsyg.2018.02690>, accessed on 12/07/21
- Lawrence, C. (2018). The Aims & Objectives of Primary School Mathematics @ <https://sciencing.com/the-aims-objectives-of-primary-school-mathematics-9725968.html>, accessed on 11/10/18.
- Middendorf, J. C. (2018). Increasing Retention through Math Study Skills, Unpublished Action Research Project Presented to the Faculty of the Special Education Graduate Program Western Illinois University in Partial Fulfillment of the Requirements for the Degree Masters of Science in Education, @ http://www.wiu.edu/graduate_studies/catalog/specialed.php, accessed on 12/08/18.
- Mubark, M. (2021). Gender and School Location Differences in Mathematics Achievement Using TIMSS Test for the Grade Eight in Jordan @ <http://dx.doi.org/10.33976/IUGJEPS.29.2/2021/22>, accessed on 11/12/21.
- Oxford Policy Management Nigeria (2017). Nigeria Teacher Development Programme-In-Service Training @ <https://datacatalog.worldbank.org/dataset/nigeria>, accessed on 1/4/19
- Ramirez, G.; Chang, H.; Maloney, E. A.; Levine, S. C. & Beilock, S. L. (2016). On the relationship between math anxiety and math achievement in early elementary school: The role of problem-solving strategies in *Journal of Experimental Child Psychology* Vol. 141 (1): 83 – 100, @ [https:// doi: 10.1016/j.jecp.2015.07.014](https://doi:10.1016/j.jecp.2015.07.014). Accessed on 12/11/21
- Schaeffer, M. W.; Rozek, C. S.; Berowitz, T.; Levine, S. C. & Beilock, S. L. (2018). Disassociating the relation between parents' math anxiety and children's math achievement: Long-term effects of a math app intervention, @ [https:// doi: 10.1037/xge0000490](https://doi:10.1037/xge0000490). Accessed on 12/11/21
- Spaniel, S. R. (2017). Students' Mathematics Self-Efficacy, Anxiety and Course Level at a Community College @ <https://scholarworks.waldenu.edu/dissertations/3579/>, accessed 15/05/22
- Zhou, D. & Liu, J. L (2020). On the different effects of teacher–student rapport on urban and rural students' math learning in China: An empirical study @ <https://doi:10.1002/pits.22446>, accessed on 28/03/22.