Vol. 15(8), pp. 495-503, August, 2020
DOI: 10.5897/ERR2020.3983
Article Number: 36A2B8864551
ISSN: 1990-3839

http://www.academicjournals.org/ERR

ACADEMIC JOURNALS
expand your knowledge

Educational Research and Reviews

Full Length Research Paper

Influence of classroom environment on senior secondary school students' academic achievement in mathematics in Calabar Nigeria

Meremikwu Anne Ndidi* and Ibok Ekpenyong Effiong

Department of Science Education, Faculty of Education, University of Calabar, Calabar, Cross River State, Nigeria.

Received 1 May, 2020; Accepted 16 July, 2020

This study examined classroom environment and mathematics achievement of senior secondary school (SS2) students' in the Calabar Cross River State, Nigeria. Ex-post facto quasi-experimental research design was used to test two hypotheses on the influence of two classroom variables, class size and instructional materials on students' academic achievement in mathematics. A sample of 700 students was selected from public secondary schools for the study using stratified and simple random sampling procedures. Two instruments used for data collection were a questionnaire on classroom environment and test items on mathematics achievement. The reliability estimate of the instrument was established through Cronbach Alpha reliability estimate and Kuder – Richardson K-R-20 formula which gave the reliability indices to range from 0.75 to 0.78. Independent t- test was the statistical technique adopted to test the hypotheses at 0.05 level of significance. The result of the analysis revealed that class size and availability of instructional facilities significantly influenced students' academic performance in mathematics among SS 2 students in Calabar Nigeria. Based on this finding, increased government funding for provision of conducive classroom environment, with optimum class sizes is recommended. Instructional materials for teaching mathematics should be made available in public schools.

Key words: Class size, instructional facilities, mathematics, achievement.

INTRODUCTION

Across the nations of the world, the teaching and learning of mathematics is accorded the utmost importance because mathematics is believed to play a key role in accelerating social, economic and technological development. In Nigeria, the educational policy accords high priority to the teaching of mathematics, and has made the subject mandatory for all Primary and Secondary School students, and a compulsory entry requirement into all science and technology courses in tertiary institutions (Federal Republic of Nigeria, 2014). To celebrate the beauty and importance of mathematics and its essential role in everyone's life, the 40th General

*Corresponding author. E-mail: annemeremikwu@yahoo.com.

Conference of UNESCO held on November 26th 2019, approved the Proclamation of March 14 (Pi Day) as the International Day of Mathematics (International Mathematics Union, 2019). Mathematics is indeed beautiful and worthy of celebration but unfortunately a significant proportion of students dislike or are afraid of mathematics rather than celebrate it. Poor attitude towards mathematics and fear of the subject are known to adversely influence learning and result in poor students' performance in the subject (Karjanto, 2017; Sule et al. 2016). A survey of 784 higher secondary school students in southern district of West Bengal to assess the attitudes students of different streams (Science, Arts and Commerce) towards mathematics showed strong association between the students' attitude towards mathematics and their achievement in mathematics (Kundu and Ghose, 2016)

Despite the priority attention given to the subject, high failure rates in mathematics among high school students in internal and national examinations remains a major concern to educational authorities and parents. For instance, the West African Senior School Certificate Examination (WASSCE) Chief Examiner's report for the years 2006-2016 specifically noted that the performance of students in mathematics was generally poor. The report showed that more than 50% of the students who sat for the examinations performed below credit level in mathematics (WAEC, 2016).

Factors that influence students' performance in mathematics have been well studied but this subject area remains a research priority especially in countries like Nigeria where students' failure rates in the subject remain high. Recent Nigerian studies have identified non-conducive learning environment, poor teacher-student relation and non-application of instructional materials in teaching mathematics as factors that may be causally related to mathematics phobia and poor students' performance in mathematics (Olaniyan and Salman, 2015; Nwoke and Ugwuegbulam, 2016). Another study in the country found shortage of well-trained mathematics teachers, inadequate teaching facilities, large classes, mathematics phobia, lack of laboratories and libraries to be associated with poor students' performance in mathematics (Sa'ad et al., 2014). elsewhere in Africa, a study of public secondary schools in Kenya that assessed the influence of students' attitude on performance in mathematics showed that students that perceived mathematics as a difficult subject were less motivated to learn mathematics and more likely to do poorly in the subject (Karigi and Tumuti, 2015). Another study that assessed the effects of human and material resources on mathematical literacy which involved economic, social and cultural status, and the cumulative expenditure on education (Aztekin and Yilmaz, 2014),

Among these myriads of factors that are known to influence students' performance in mathematics, classroom environment has commonly implicated in studies. Lizzio et al. (2002) in a study of university students found that students' perceptions of the learning environment influenced wide spectrum of learning outcomes including academic achievement, development of key skills and satisfaction with learning. The study also concluded that students' perceptions of their current learning environment were a stronger predictor of learning outcomes at university than prior achievement at school. Another survey in Cross River State that involved 1200 Junior Secondary 2 (JS2) students from 48 secondary schools showed that the following classroom environment variables (viz. time utilized by teacher; physical layout of classroom; classroom climate; teacher's motivation of students; instructional material utilization; classroom management skills; teacher-student classroom interaction and student-student classroom interaction) were individually and collectively predictive of students' mathematics achievement (Igiri et al., 2014).

Class size and the availability of suitable instructional materials are two components of the classroom which stand out as key modifiable factors (Spinner and Fraser, 2005). Effective teaching and learning cannot take place in poorly managed classrooms. Poor classroom environment is characterized by crowded population, poor learning facilities, lack of sitting accommodation and lack of instructional materials. It is common knowledge that lack of instructional facilities or inadequate use of instructional facilities and large class size characterize the classroom environment of many public schools in Nigeria. The persistence of these inadequacies of the classroom in Nigerian public schools contribute remarkably to poor learning outcomes reflected by high failure rates in mathematics as reported by the West African Senior School Certificate Examination (WAEC, 2016).

Our review of literature in this subject area shows that class large class size adversely influenced learning outcome. A study of 337 randomly selected Senior Secondary School students in Yobe State Nigeria showed that the students taught in an ideal learning environment performed significantly better in mathematics achievement tests than the students taught in a dull learning environment (Shamaki, 2015). Another recent study of senior secondary school students in Nigeria found that large class size was associated negative effect on students' academic performance in biology (Adimonyemma et al., 2018). The study also observed that large class size had adverse psychological and social effect on students which may have indirectly affected their academic performance. Also, a cross-sectional survey involving 30 lecturers and 520 final year students of tertiary institution in Nigeria revealed that large class size adversely affected the teaching and learning of Business Education (Ayeni and Olowe, 2016). In Uganda, another African country, a study of high

school students identified students' perception of good classroom as a significant predictor of students' achievement in mathematics along with parental support, peer influence, prior Mathematics achievement and attitude toward mathematics (Kiwanuka et al., 2015). Meta-analysis of studies that assessed the effect of class size on student achievement concluded that classroom size reduction (CSR) generally had positive effects on students' performance in all subject areas (Shin and Chung, 2009). A longitudinal study of kindergarten students and teachers randomly assigned to small and large classes within participating schools concluded that students in small classes outperformed their counterparts in classes of regular size (Finn and Achilles, 1990).

The assertion that learning is enhanced by appropriate use of instructional materials is widely studied and accepted to be true yet contextual variations and the complex nature of mathematics and related science subjects make it imperative to continue to research this subject area in a bid to explore intervention options that may offer novel opportunities to enhance learning outcomes. Abdi (2017) in a study of institutional factors that influenced students' performance in public secondary schools in Somaliland, observed that instructional materials and school facilities significantly influenced students' academic performance more than teacher characteristics did. In Nigeria, Adimonyemma et al. (2018) and Olayinka (2016), in two separate studies reported that adequacy of instructional facilities in the classroom environment significantly influenced students' performance in biology and social studies respectively.

Results of studies cited in the foregoing review of literature on effects of class size and instructional materials suggest that improvement in these classroom variables, namely, provision of adequate instructional materials and reduction of class sizes could contribute to efforts to improve learning outcomes in mathematics in settings where these conditions are currently suboptimal.

Purpose of study

The study aimed to assess the influence of two elements of classroom environment namely instructional facilities and class size on the performance senior secondary school students in mathematics. This study is premised on a national context characterized by sub-optimal classroom resources and preponderance of poor students' attitude to mathematics.

Statement of hypotheses

The following null hypotheses were formulated to guide the study:

(i) Class size does not have a significant influence on students' academic performance in Mathematics.
(ii) Instructional facilities do not have a significant influence on students' academic performance in Mathematics.

Conceptual and theoretical framework

The foregoing review of literature show that the environment within which teaching and learning occurs can influence the effectiveness of teaching, attitude and performance students in mathematics. The conceptual framework for this study seeks to provide a construct for understanding interaction between student's attitude or perceived self-efficacy and two elements of classroom environment namely, class size and instructional materials, and how these may influence student's achievement in mathematics. The framework derives from three related concepts. The first that is the widely held believe that the classroom environment influences the process of teaching and learning, and is a determinant of students' performance (Ogbuehi and Fraser, 2007). The second concept is that a child's attitude and self-efficacy belief can be influenced by the classroom environment (Dorman, 2001; Zedan and Bitar, 2014; Daemi et al., 2017). This is rooted in the self-efficacy component of Bandura's social cognitive theory. This theory provides a construct to explain people's beliefs about their own capacities to perform an activity or achieve an objective (Bandura, 1997). Pajares (1996) elaborating on the application of Bandura's self-efficacy theory to academic tasks, stated that students who have high academic self-efficacy tend to perform demanding tasks more often, and in the process gain higher knowledge and proficiency than students with low self-efficacy.

McMahon et al. (2009) in a study of fifth and sixth grade students from California showed that classroom environment influenced the student's academic self-efficacy. Another study involving 1309 seventh and eighth grade mathematics students in Hong Kong and USA found significant positive relationships between classroom learning environment and the students' academic self-efficacy (Hanke, 2013).

The third concept derives from the evidence that students' preference for mathematics and their achievement in mathematics is influenced by factors that influence self-efficacy belief in the subject. Researchers have shown that students' interest in mathematics and their choice of math-related courses is influenced by their academic self-efficacy belief (Hackett and Betz, 1989; Pajares and Miller, 1995). A study by Collins (1982) cited by Schunk (1989), which involved children with low, middle and high mathematics ability who had either high or low self-efficacy showed that although ability influenced students' performance, high self-efficacy was associated with higher performance regardless of ability.

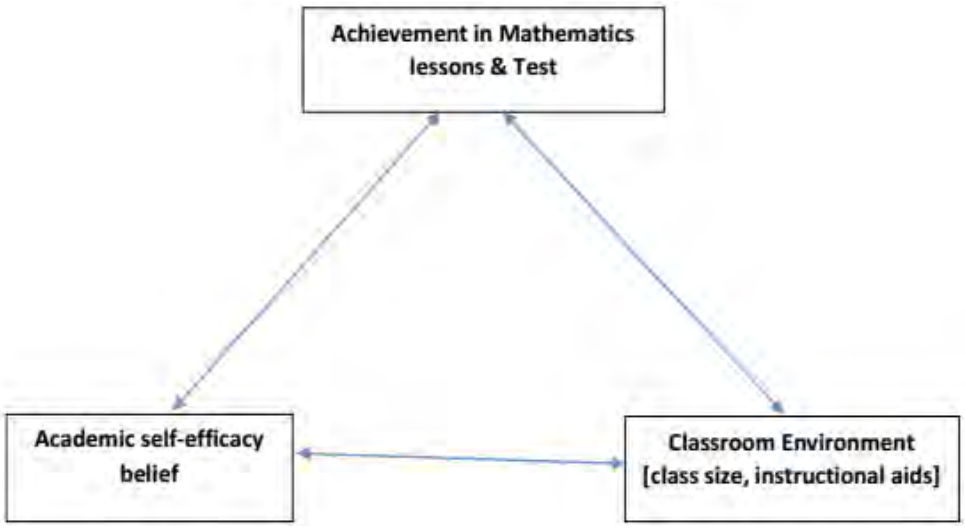

Figure 1. Conceptual framework on relationship of classroom environment, mathematics self-efficacy and achievement.
Source: Adapted from Tosto et al. (2016).

Children with high self-efficacy completed more problems correctly and reworked more of the ones they missed. The triangular conceptual model expressed in Figure 1 shows the direct relationship between mathematics achievement on one hand, and self-efficacy belief or classroom environment on the other. It also shows that changes in classroom environment indirectly impacts on mathematics achievement by its influence on the student's self-efficacy belief.

The theoretical basis for using instructional materials to aid the teaching of mathematics derives from the Dale-Brunner learning theory of "Cone experience" (Bruner, 1966; Dale, 1969) (Figure 2). The theory postulates that learners profit more from abstract instructions when they have had related concrete experiences that give meaning to abstract representations of reality. In the context of this study, the abstract instructions refer to mathematical problems (including mathematical symbols) while the use of instructional materials represent the concrete experiences that would give meaning to the abstract representations of reality expressed in the mathematical problems. The theory suggests that for learning to take place easily and smoothly at a foundational level, the use of practical instructional aids is essential. Foundational level may refer to primary education or, when applied at higher levels of education (secondary or tertiary) refers to use of instructional materials (for example audio-visual, media material) to aid learners to better appreciate newly introduced abstract mathematical concepts. Learners at the base of the cone who are at the earliest (enactive) phase of development or high school students who are being introduced to a new abstract topic area therefore need concrete manipulative instructional aids or visual models for better understanding of the concept. Learners at near the top of the cone should have increasing ability to understand abstract concepts and symbols with less need for concrete instructional aids.

The current study, sought to examine the influence of classroom environment on mathematics achievement of Nigerian secondary students. In conceiving the study, it was assumed that positive modification of the class room environment by improving on availability and use of instructional materials and implementing optimum class size would impact positively on the effectiveness of teaching and the students' academic self-efficacy with overall improvement in their performance in mathematics achievement tests.

METHODOLOGY

The study area was Calabar Education Zone of Cross River State in Southern Nigeria. The research design used for this study was the ex-post facto design with class size and instructional facilities as the independent variables. The sample of 700 students was draw from the population of all Senior Secondary level two classes (SS2) in Public Secondary Schools in Calabar Education Zone which make up a total of 6,996 students 84 public secondary schools. A multi-stage sampling technique involving stratified and simple random technique were adopted in selecting approximately 10% of the total number of students using proportional sampling technique giving a total sample of 700 students.

Two instrument were used; a questionnaire on classroom environment and Mathematics achievement test items. The questionnaire title "classroom environment" consisted of two sections, A and B. Section A described the bio data of the respondent and class size while section B was developed on the main variable namely instructional facilities which consisted of 6 items to elicit respondents' opinion on instructional facilities. The

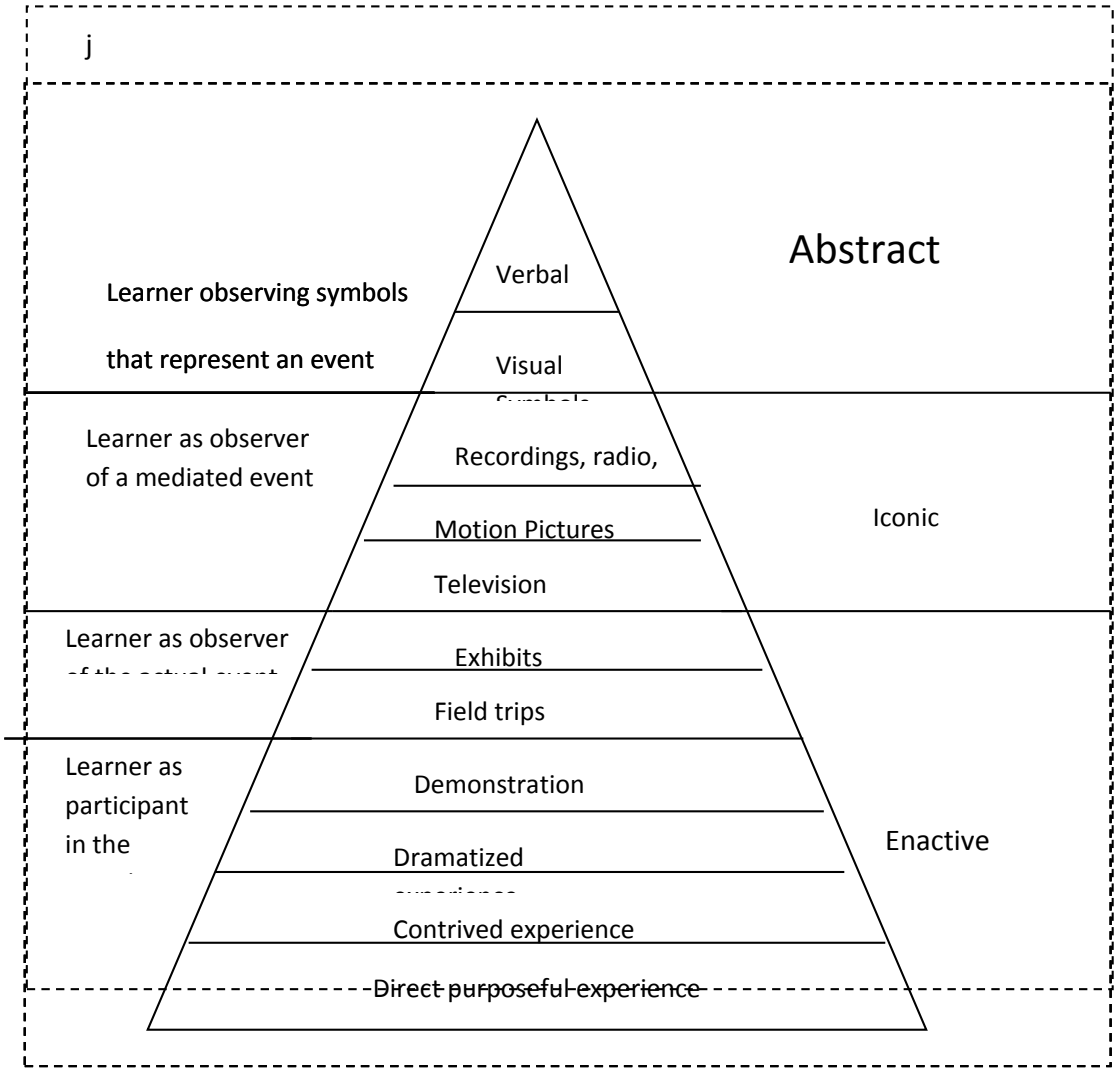

Figure 2. Dale-Bruner theory of cone experience.
Source: Heinich et al. (1982).

questionnaire was based on four-point scale used in measuring responding opinion level of agreement or disagreement such as strongly agree, agree, disagree and strongly disagree. Mathematics achievement test consisted of 40 items constructed by the researchers was used to test pupils' ability in Mathematics tasks. The instrument was face-validated by two experts in measurement and evaluation from the University of Calabar. Corrections and adjustments were made on the instruments based on the advice of the expert to enhance the validity. The reliability estimate of the questionnaire was established through Cronbach Alpha reliability estimate which give 0.75 and 0.78 while students' achievement test was established through Kuder Richardson formula K-R20 which give 0.77. The Statistical Package for Social Sciences (SPSS) computer programme was used to analyze the data collected. Independent t-test was applied as inferential statistics in testing the two hypotheses, with significance level set at 0.05.

We defined a class of < 40 students as small and class of ≥ 40 students as large based on the stipulation of the National Policy on Education (Federal Republic of Nigeria, 1981).

RESULTS

The results of the analysis are presented in the Tables 1 and 2.

Hypothesis one

Class size does not have a significant influence on students' academic performance in Mathematics.

The independent variable in this hypothesis is class size while the dependent variable is students' academic performance in mathematics. To test this hypothesis, class size was classified into two groups (Large and small). Based on the classification, the means scores of study participants were compared using independent t-test and the result presented in Table 1.

Table 1. Independent t-test analysis of influence of class size on students' academic performance in Mathematics.

Variable	N	X	SD	t	p-value
Large	395	14.12	6.52		
Small	305	16.23	5.92	4.473	0.00
Total	700	15.04	5.88		

*Significant at 0.05 level of significance.

Table 2. Independent t-test analysis of influence of instructional facilities on students' academic performance in mathematics.

Variable	N	X	SD	t	p-value
Adequate	326	17.68	6.75		
Adequate	374	13.21	6.92	8.638	0.00
Total	700	15.28	6.28		

*Significant at 0.05 level of significance.

The result of the analysis (t=4.473; p=.000) as presented in Table 1 indicates that there is a significant relationship between class size and students' performance in mathematics. The mean performance score of students in small classroom (16.23) is significantly higher than the mean of those in large classroom (14.12), and the null hypothesis was rejected at 0.05 level of significance. and alternative hypothesis was accepted. This means that higher number of students in a class was associated with lower students' performance scores in Mathematics.

Hypothesis two

Instructional facilities do not have a significant influence on students' academic performance in mathematics.

The independent variable in this hypothesis is instructional facilities while the dependent variable is students' academic performance in mathematics. To test this hypothesis, instructional facilities were classified into two groups (adequate and inadequate). Based on the classification, their means were compared using the independent t-test analysis and the result presented in Table 2.

The result of the analysis (t=8.638; p=0.000) as presented in Table 2 indicates that instructional facilities significantly influenced students' academic performance in mathematics. With this result, the null hypothesis was rejected at 0.05 level of significance and alternative hypothesis was accepted. The mean score of students taught with adequate use of instructional materials (17.68) is higher than the mean score of those taught with inadequate use of instructional materials (13.21). This implies that appropriate use of instructional materials would enhance students' academic achievement in Mathematics.

DISCUSSION

The result of the first hypothesis revealed that smaller class size is significantly associated with better students' performance in mathematics achievement tests. This finding is in agreement with the result of several other studies that addressed similar research question. The results of this study are similar to the result of a comparative study involving senior secondary school student in Northern Nigeria which assessed influence of components of learning environment on students' mathematics achievement. This showed that the mean score of students taught in an ideal learning environment was significantly higher than mean score of those taught and the students taught in less optimal learning environment (Shamaki, 2015). The classroom environment variables assessed in that study were classroom painting and lighting, climate and ventilation, seats and sitting arrangement, chalkboard and number of students per class. The variables assessed in this study which were also assessed by our study were the number of students per class, and chalkboard as an instructional material.

Also, a recent Nigerian study of the effect of class size on students' academic performance found that large class size was associated with negative effect on students' academic performance in biology. The study also observed that large class size had psychological and social effect on students, and that this was likely to have

affected their academic performance (Adimonyemma et al., 2018).

Another study involving 1763 students of a US public university which examined how classroom environment and student personality influences student satisfaction and performance found that personality characteristics (namely agreeableness and conscientiousness) and the structural dimension of classroom environment structure were all positively related to both satisfaction and academic performance (Pawlowska et al., 2014). This study further showed that interpersonal factors within the classroom environment influence the outcome of learning.

While our study and the study by Shamaki (2015) assessed the effects of physical elements of the classroom environment, they failed to assess interpersonal factors as did the study by Adimonyemma et al. (2018) and Pawlowska et al. (2014). As shown by these two studies, large class sizes have been shown to have negative effect of interpersonal relationships among students and teachers. It is likely that better interpersonal relationships among students in smaller class sizes contributed to the better performance observed among these students, compared to their counterparts in larger classes.

Contradicting this finding, another Nigerian study by Owoeye and Yara (2011) which analyzed the results of 50 schools in the West African School Certificate Examination (WASCE) found no statistically significant difference between the performance of students in large classes and small classes. The result of that study may have been influenced by confounding and methodological issues inherent on using aggregated data from administrative records retrospectively. The analytical process in this study differs from theirs in that our study used individual participants' data obtained prospectively while the study by Owoeye and Yara (2011) used aggregate data from published WASCE results.

Report of meta-analysis of research on class size and educational achievement concluded that there was a clear and strong relationship between class size and achievement with students in smaller classes doing better (Glass and Smith, 1979). This relationship was reported to have been more pronounced in well-controlled studies where pupils were randomly assigned to classes of different sizes. The participants in our study were randomly assigned to study arms thus minimizing selection bias, and this could partly the differences in the conclusions reached by our study and theirs. The results of that meta-analysis also suggested that the relationship between class size and academic achievement appeared to be stronger in secondary than primary schools. It is unclear if the fact that we studied secondary school students has in any way contributed to the study results as suggested by Glass and Smith (1979) in their meta-analysis.

The result of the second hypothesis revealed that teaching with adequate instructional facilities was associated with significantly higher students' performance in mathematics achievement tests. Our results are in consonance with the findings of Bassey et al. (2010) and those of Olayinka (2016) who in separate studies reported that adequacy of instructional facilities in the classroom environment significantly influenced students' performance in mathematics and social studies respectively. Bassey et al. (2010) in a study conducted among senior secondary school students in Cross River State Nigeria showed that non-availability and non-use of instructional materials by schools were independently associated with poorer performance of their students in mathematics achievement tests. It is important to note that the control arms in our study as in the other two Nigerian studies were made up children in the usual classroom situation of the public schools in the country, mostly characterized by deficiencies in instructional facilities.

Also, study by Oladejo et al. (2011) which compared teaching of physics with improvised and standard instructional materials showed that the students taught with improvised instructional materials obtained the highest achievement score at post-test, followed by those with standard instructional materials, while the control group scored the lowest. The result of this study shows that improvised instructional materials could be as effective as or better than standard instructional materials if appropriately applied. Again, given that the control arm of this study and ours represents children in the usual situation of public school classrooms in Nigeria, these results highlight the deficiencies in provision of instructional facilities in the nation's public schools. These studies and ours show how the persisting lack of essential learning resources could adversely impact on learning outcomes in Nigerian public schools in general, and particularly mathematics classroom.

A key limitation of our study being of quasi-experimental design is the failure to apply statistical adjustment for confounding effects and risk of bias inherent non-randomised and observational studies. Another limitation of our study its focus on the structural dimension of classroom environment while failing to assess interpersonal factors which are known to also influence the outcome of learning within the classroom environment. For instance, Pawlowska et al. (2014) showed that classroom environment as well as student personality influenced student satisfaction and academic performance.

CONCLUSION AND RECOMMENDATION

This study has shown that small class size and use of instructional materials positively influence learning

outcomes in mathematics. The students in the control arms of our study and others performed poorly because they were in their usual classroom situation characterized by large-sized classes and deficiency of instructional materials. The findings highlight resource gap in educational system which adversely impact on the teaching and learning of mathematics in particular. Provision of instructional materials will require increase in funding of public schools which is bound to pose a major challenge with worsening economic situation in many countries. Parents, teachers and students should be encouraged to make improvised instructional materials. This has the potential to mitigate the effect of declining resources due to the effects of COVID-19 on the economies of many low and middle income countries.

This study has highlighted poor compliance with the National Educational Policy which stipulates maximum class sizes of 20, 30 and 40 for pre-primary, primary and secondary schools respectively (Federal Republic of Nigeria (1981). Programme to reduce class sizes would entail cost-intensive interventions like construction or reconstruction of classrooms and procurement of equipment. Innovative, cost-efficient approach to mitigate the effects of large class size in public schools could include rotation of students to teach them in small groups, and provision of virtual electronic learning platforms and materials by radio, television and the internet.

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

ACKNOWLEDGEMENT

The authors appreciate the University of Calabar, for the intramural support for the academic and research activities.

REFERENCES

Abdi MK (2017). Institutional factors and student performance: A survey on public secondary schools in Hargeisa City, Somaliland. International Journal of Education and Research 5(3):45-54.

Adimonyemma NR, Akachukwu EE, Igboabuchi NA (2018) Impact of Class Size on Students' Academic Performance in Biology in Idemili North Local Government Area of Anambra State. International Journal of Education and Evaluation 4(8):22-32.

Ayeni OG, Olowe MO (2016). The Implication of Large Class Size in the Teaching and Learning of Business Education in Tertiary Institution in Ekiti State. Journal of Education and Practice 7(34): 65-69.

Aztekin S, Yilmaz HB (2014). The effects of human and material resources on students' math achievement in 45 countries. Problems of Education in the 21st Century. 62:8-20.

Bandura A (1997). Self-efficacy: The exercise of control. New York: Freeman.

Bassey SW, Ndiyo NA, Joshua MT (2010). The influence of instructional materials on mathematics achievement of senior secondary students in Akamkpa Local Government Area of Cross River State, Nigeria. African Journal of Educational Studies in Mathematics and Sciences 8:101-112.

Bruner JS (1966). Toward a theory of instruction. USA: Cambridge Harvard University Press. P. 49.

Collins JI (1982). Self-efficacy and ability in achievement behavior. Paper presented at the Annual Meeting of the American Educational Research Association, New York.

Daemi MN, Tahriri A, Zafarghandi AM (2017). The relationship between classroom environment and EFL learners' academic self-efficacy. International Journal of Education and Literacy Studies 5(4):16-23.

Dale E (1969). Audio visual methods in teaching (3rd edition) New York: Holt, Rinehart and Winston.

Dorman JP (2001). Associations between classroom environment and academic efficacy. Learning Environments Research 4(3):243-257.

Federal Republic of Nigeria (2014). National Policy on Education (Revised Edition) Lagos: NERDC Press.

Federal Republic of Nigeria (1981). National Policy on Education (Revised Edition) Lagos: NERDC Press.

Finn JD, Achilles CM (1990). Answers and questions about class size: A statewide experiment. American Educational Research Journal 27(3):557-577.

Glass GV, Smith ML (1979). Meta-analysis of research on class size and achievement. Educational Evaluation and Policy Analysis 1(1):2-16.

Hanke CYC (2013). A cross-national study of students' perceptions of mathematics classroom environment, attitudes towards mathematics and academic self-efficacy among middle school students in Hong Kong and the USA (Doctoral dissertation, Curtin University). Retrieved from https://espace.curtin.edu.au/bitstream/handle/20.500.11937/2575/199177_Hanke%22014.pdf?sequence=2

Hackett G, Betz NE (1989). An exploration of the mathematics self-efficacy/ mathematics, performance. Correspondence Journal for Research in Mathematics Education 20(3): 261-273.

Heinich R, Molenda M, Russell JD (1989). Instructional media and the new technologies of instruction (2nd edition). New York: John Wiley and Sons.

Igiri IE, Meremikwu AN, Ekuri EE, Asim AE (2014). Classroom environment variables and mathematics achievement of junior secondary school students in Cross River State, Nigeria. In: Pope, S. (Ed.) Proceedings of the 8th British Congress of Mathematics Education, BCME 2014, 191-198 Available at www.bsrlm.org.uk

International Mathematics Union (2019). Mathematics is everywhere – Proclamation by UNESCO of March 14 as the International Day of Mathematics. Press information, embargo until 26.11.2019. https://www.mathunion.org/fileadmin/IMU/ Press Release/2019-11-24-Press-Release-IDM-en-V2.pdf (accessed 27/4/2020)

Karigi MW, Tumuti S (2015). Students' and teachers' attitude factors contributing to poor performance in mathematics in Selected Public Secondary Schools in Kiambaa Division of Central Province, Kenya. Strategic Journal of Business and Change Management 2(58):316-332.

Karjanto N (2017). Attitude toward mathematics among the students at Nazarbayev University Foundation Year Programme. International Journal of Mathematical Education in Science and Technology 48(6):849-863.

Kiwanuka HN, Van Damme J, Noortgate WVD, Anumendem, DN, Namusisi S (2015). Factors affecting Mathematics achievement of first-year secondary school students in Central Uganda. South African Journal of Education 35(3):16. doi: 10.15700/saje.v35n3a1106

Kundu A, Ghose A (2016). The relationship between attitude towards and achievement in mathematics among higher secondary students. International Journal of Multidisciplinary Research and Development, 3(6):69-74.

Lizzio A, Wilson K, Simons R (2002). University Students' Perceptions of the Learning Environment and Academic Outcomes: Implications for theory and practice, Studies in Higher Education 27(1):27-52.

McMahon SD, Wernsman J, Rose DS (2009). The relation of classroom environment and school belonging to academic self-efficacy among

urban fourth and fifth grade students. The Elementary School Journal 109(3): 267-281.
Nwoke BI, Ugwuegbulam CN (2016). Causes and solutions of mathematics phobia among secondary school students. Research on Humanities and Social Sciences 6(20):105-109.
Ogbuehi PI, Fraser BJ (2007). Learning environment, attitudes and conceptual development associated with innovative strategies in middle-school mathematics. Learning Environments Research 10(2):101-114.
Oladejo MA, Olosunde GR, Ojebisi AO, Isola OM. (2011). Instructional Materials and Students' Academic Achievement in Physics: Some Policy Implications. European Journal of Humanities and Social Sciences 2(1):112-126.
Olaniyan MO, Salman MF (2015). Causes of mathematics phobia among senior school students: Empirical evidence from Nigeria. The African Symposium 15(1):50-56.
Olayinka ARB (2016). Effects of instructional materials on secondary school students' academic achievement in social studies in Ekiti State, Nigeria. World Journal of Education 6(1):32-39.
Owoeye JS, Yara PO (2011). Class size and academic achievement of secondary school in Ekiti State, Nigeria. Asian Social Science 7(6):184-189.
Pajares F (1996). Self-efficacy beliefs and mathematical problem solving of gifted students. Contemporary Educational Psychology 21(4):325-344.
Pajares F, Miller MD (1995). Mathematics self-efficacy and mathematics outcomes: The need for specificity of assessment. Journal of Counseling Psychology 42(2): 190-198.
Pawlowska DK, Westerman JW, Bergman SM, Huelsman TJ (2014). Student personality, classroom environment, and student outcomes: A person–environment fit analysis. Learning and Individual Difference 36:180-193.
Sa'ad TU, Adamu A, Sadiq AM (2014). The Causes of Poor Performance in Mathematics among Public Senior Secondary School Students in Azare Metropolis of Bauchi State, Nigeria. IOSR Journal of Research and Method in Education 4(6):32-40.
Schunk DH (1989). Self-efficacy and achievement behaviors. Educational Psychology Review 1:173-208
Shamaki TA (2015). Influence of Learning Environment on Students' Academic Achievement in Mathematics: A Case Study of Some Selected Secondary Schools in Yobe State – Nigeria. Journal of Education and Practice 6(34):40-44.
Shin I, Chung JY (2009). Class size and student achievement in the United States: A meta-analysis. Korean Journal of Educational Policy 6(2): 3-19.
Spinner H, Fraser BJ (2005). Evaluation of an innovative mathematics program in terms of classroom environment, student attitudes, and conceptual development. International Journal of Science and Mathematics Education 3(2):267-293.
Sule B, Hussaini MM, Bashir US, Garba A (2016). Mathematics Phobia among Senior Secondary School Students: Implication for Manpower Development in Science Education in Nigeria. International Journal of Education and Evaluation 2(8):16-21.
Tosto MG, Asbury K, Mazzocco MM, Petrill SA, Kovas Y (2016). From classroom environment to mathematics achievement: The mediating role of self-perceived ability and subject interest. Learning and individual differences 50:260-269.
West African Examinations Council (2006-2016). Chief Examiner's reports (Nigeria) SSCE, May/June examinations.
Zedan R, Bitar J (2014). Environment of learning as a predictor of mathematics self-efficacy and math achievement. American International Journal of Social Science 3(6):85-97.