Effects Of Flipped Classroom Instructional Strategy on Secondary School Students' Achievement in Mathematics in Nnewi Education Zone of Anambra State, Nigeria

CHUKWUNYELU Onyedika Maduegbunam[1], OKIGBO Ebele Chinelo[2]
[1]Department of Science Education,
Nnamdi Azikiwe University, Awka, Anambra State, Nigeria.
[2] Department of Science Education,
Nnamdi Azikiwe University, Awka, Anambra State, Nigeria.
dikajesus1@yahoo.com[1], ec.okigbo@unizik.edu.ng[2]
DOI: 10.56201/ijasmt.vol.11.no1.2025.pg51.61

Abstract

The effects of flipped classroom instructional strategy (FCIS) on academic achievement of SS 2 students in mathematics in Nnewi Education Zone of Anambra State, Nigeria was determined. Two research questions and three hypotheses tested at 0.05 level of significance guided the study. The research adopted a quasi-experimental design, specifically, pre-test and post-test non- randomized control group design. The population comprised 4006 students in the public secondary schools in Nnewi Education Zone of Anambra State, Nigeria. The sample size was 86 (49 male and 37 female) students selected from two of the 37 co-educational public secondary schools in the Zone through multistage sampling procedure. Mathematics Achievement Test (MAT) was used as instrument for data collection while researchers-developed FCIS lesson plan was used as instructional tool. The reliability co-efficient value for MAT was 0.90 which was established using Kudder-Richardson Formula 20. Experimental group was taught using FCIS while the control group was taught using Lecture method (LM). Mean and standard deviation were used to answer the research questions while the hypotheses were tested using Analysis of covariance. The findings showed among others that, FCIS significantly improved students' achievement in mathematics and gender does not have significant effect on the achievement of students' taught mathematics using FCIS and LM. The study concludes that FCIS is effective in improving the achievement of SS 2 students in mathematics. Based on the findings, it was recommended among others that; Curriculum planners should adopt FCIS as an innovative teaching strategy in planning mathematics curriculum and that mathematics teachers should use FCIS in teaching mathematics for improved achievement.

Keywords: *Flipped classroom, Mathematics, Achievement, SS 2 Students.*

1. Introduction

Education is a core learning process which facilitates acquisition of knowledge, skills, beliefs, values and habits. It is a lifelong process which takes place formally, informally or non-formally. Education helps individuals develop critical thinking, problem solving and communication skills, preparing them for personal, social and professional growth. Pi-Day (2019) identified mathematics as one of such subjects known to facilitate analytical thinking and improves rational reasoning in individual's mind.

Mathematics is the study of numbers, shapes, quantities and relationships between them. Okigbo & Anyanwumelu (2021) define mathematics as the study of relationship which revolves around the elementary practice of writing, measuring and describing of shapes and objects. It involves the use of logical reasoning, problem solving and abstraction to develop and apply mathematical theories, models and techniques. It is studied at all levels of secondary education as a core and compulsory school subject. Due to the relevance of mathematics, other fields of knowledge are dependent on mathematics for solving problems, stating theories and predicting outcomes (Ogoke & Okigbo, 2021). Mathematics is the heart of science and technology which holds the key to the development of any nation.

Despite the relevance of mathematics in day to day living and in the scientific and technological development, it is still evident that students' achievement in mathematics at internal and external examinations has remained not encouraging (Zalmon, 2021). Zalmon & Charles-Ogan (2021) asserted that poor achievement of students in both internal and external examinations in Mathematics have been on the increase in recent time. Analysis of the students' achievement in WASSCE Mathematics between the years 2012 – 2024 reveals that performances of students in mathematics fluctuates, but generally below average in 7years out of the 13 years in view. This phenomenon has remained a source of concern to the researchers, science educators, education administrators, parents and the nation at large.

Moreover, much research had offered several reasons for the students' fluctuating achievements in mathematics. According to Awodun (2020) and Boris (2019), a number of factors have been identified as militating against students' attainment of the objectives of science instruction, and the most pronounced factor identified by researchers is the inappropriate and uninspiring instructional strategies adopted by science teachers. Oyedeji in Ogoke & Okigbo (2021), averred that the use of the conventional lecture method whereby the teacher talks about the subject while the students read about the subject is the major cause of the poor performance in mathematics. Literature is replete with reports of abysmal performance of students in mathematics resulting from ineffective instructional deliveries using lecture method (Zalmon & Wonu, 2017). Supporting this view, many research studies suggested a complete refurbishment of the public education system (Makinde, 2019), yet others like Makinde & Yusuf (2019) suggested that educators explore substitutes to the lecture method that will be student centered. According to Sunday, Abiodun & Olaoye (2021), these instructional strategies would avail the students opportunity to control their learning process as well as develop the required interest in

mathematics. According to Koh (2019), flipped classroom instructional strategy is one of such strategies.

The flipped classroom is a learning methodology that combines e-learning and the face-to-face classroom, its purpose being to improve learning by allowing students to control the time and pace of their online learning and maximize their active learning (Gutiérrez, 2022). The basic idea of the flipped learning model is to teach the course content before the course through online videos in order to allocate more time for active learning and problem solving activities in the classroom (Lo & Hew, 2017 and Yakar, 2021). Therefore, the students learn the basic information about the course/content before they come to the classroom as a result of the technological access provided by their teachers according to Hayırsever & Orhan (2018). To this end, there is need to test the outcome of teaching and learning of mathematics using flipped classroom instructional strategy. This is with the hope of investigating its effectiveness in improving secondary school students' achievement in mathematics in Nnewi Education zone of Anambra state, Nigeria.

Academic achievement, as defined by Odagboyi (2015), is the learning outcome of students which includes the knowledge, skills, and ideas acquired and retained through their course of studies within and outside of the classroom situation. According to Cheng & Liu (2019), academic accomplishment is one of the clear indications of students' success in school since it is one of the fundamental indices used to evaluate students' progress in an academic endeavor. Some scientific educators believe that gender is one of the elements that determine low achievement in science, even though researchers castigate teaching method and lack of students' interest for students' poor performance in the subject (Agbasi & Okeke, 2020). This study also ascertains how gender affects students' achievement when they are taught mathematics using flipped classroom instructional strategy.

Gender is a socially constructed definition of men and women. Godpower-Echie & Owo (2019) defined gender as the stratification and assignment of roles along sex line which may be culturally determined, and is ascribed to male and female. It is a socio-cultural construct that assigns roles, attitudes and values considered appropriate for each sex. In the same vein, the gender difference in interest of students in mathematics has been a thing of worry to mathematics educators and researchers. Gender disparity in mathematics achievement is one that cannot be swept under the carpet. Modern psychology studies have shown that gender as a variable relates to interest (Agbasi & Okeke, 2020). Ossai (2023); Ogoke & Okigbo (2021) & Amatobi and Amatobi (2020) in their different studies, discovered that there is no significant difference on the academic achievement of male and female students, while some others like Tarfa & Dike (2022) established significant difference particularly during early education. Allahnana et *al.* (2018) earlier found that the achievement of girls in mathematics are worse than that of the boys on the average because of their lack of interest in the subject. This calls for serious attention and if unchecked, it would be a great challenge to gender equality in Mathematics. This necessitated the present study which tries to fill gap that has been identified in literature. Hence, this study determined the effect of flipped classroom instructional strategy on secondary school male and

female students' academic achievement in mathematics in Nnewi Education zone of Anambra State, Nigeria.

I. Purpose of the Study

The study determined the effect of Flipped classroom instructional strategy on secondary school students' achievement in mathematics in Nnewi Education Zone of Anambra State. Specifically, this study determined:

1. Mean achievement scores of students taught mathematics using flipped classroom instructional strategy (FCIS) and that of those taught using lecture method (LM).
2. Mean achievement scores of male and female students taught mathematics using FCIS and that of those taught using LM.

II. Research Questions

The study was guided by the following research questions:

1. What are the differences in mean achievement scores of students taught mathematics using FCIS and that of those taught using LM?
2. What are the differences in mean achievement scores of male and female students taught mathematics using FCIS and that of those taught using LM?

III. Hypotheses

The following hypotheses were stated to guide the study at 0.05 level of significance:

1. There is no significant difference in the mean achievement scores of students taught mathematics using FCIS and that of those taught using LM.
2. There is no significant difference in the mean achievement scores of male and female students taught mathematics using FCIS and that of those taught using LM.
3. There is no significant interaction effect of instructional strategies (FCIS & LM) and gender on students' achievement in mathematics.

IV. Methodology

The researcher adopted pretest-posttest non-randomized control group quasi- experimental design. Thus, intact classes were used in each school. The study was conducted in Nnewi Education Zone of Anambra State, Nigeria. The population consisted of 4,006 senior secondary class two (SS 2) students (1,936 males and 2,070 females) offering mathematics in all the public secondary schools in the Nnewi Education Zone. The study's sample consisted of 86 (49 male and 37 female) SS 2 students offering mathematics, selected from two out of the 37 co-educational public secondary schools in the Zone. A multistage sampling procedure was used to sample the participants namely: purposive sampling, simple random sampling and lucky dip without replacement techniques. Mathematics Achievement Test (MAT) was used for data collection. The MAT contained 50 item multiple choice objective questions with options A – D adapted from three testing organizations: the West African Examination Council (WAEC), the National Examination Council (NECO), and the National Business and Technical Examinations Board (NABTEB) for

the years 2018 - 2022 and each correct answer attracted 2 marks. Research assistants who are the regular mathematics teachers taught the students in each group using researchers' developed lesson plans on FCIS and LM. Three experts validated the instruments, each from Departments of Science Education, Educational foundations (Measurement and Evaluation Unit) and Mathematics, from Nnamdi Azikiwe University, Awka. The reliability of the MAT was established using Kudder-Richardson 20 Formula. The coefficient of internal consistency obtained was 0.90.

The researchers trained the regular mathematics teachers in the sampled schools to serve as research assistants, which lasted for one week over three contacts. They taught their students in each school using regular school time table, of two contacts per week. The experimental group (FCIS) was taught by the research assistant using Flipped classroom instructional strategy making use of the researcher-developed FCIS lesson plan and flipped classroom model (recorded video of the math's lesson). In the pre-class phase of FCIS, a developed flipped classroom model was uploaded to the already existing class WhatsApp platform so that students could watch videos, listen to audio lessons, and read text lessons at home or at any other convenient locations using their phones or their parents' or guardians' phones before engaging in the in-class activities. After going through the online video lessons, students were given a short quiz to complete as a way of confirming they read, listened, or watched the video prior to class discussion. Major assignments or projects on the subject were to be completed together by the teacher and the students, either individually or in groups with classmates during the interactive period of the in-class phase, and any group of students or individual needing assistance were entertained by the teacher. The control group (LM), on the other hand, was taught using the usual lecture method of teaching, with lesson notes developed by the researchers to reflect the same learning objectives as the FCIS equivalent. The group was evaluated at the appropriate time with the same test instrument: MAT used for the experimental group. The actual treatment lasted for five weeks (week 2 – week 6) in each of the schools. The first week was for administering the pre-test (MAT) while the sixth week was for the revision and administering of the post-test. The Experimental group was taught using Flipped classroom Instructional Strategy (FCIS) while the control group was taught using Lecture Method (LM). Mean and Standard deviation were used to answer the research questions while the hypotheses were tested using Analysis of Covariance at 0.05 level of significance because addresses the imbalance of non-equivalence in groups caused by non-randomization of participants. The p-value and alpha level ($\alpha = 0.05$) were compared to determine whether to retain or reject the null hypotheses tested. When the precise probability value was less than or equal to the 0.05 level of significance, the null hypothesis was rejected; but, when the exact probability value was more than the 0.05 level of significance, the null hypothesis was not rejected.

V. Results

Research question 1: What are the differences in mean achievement scores of students taught mathematics using FCIS and those taught using Lecture method LM?

Table 1: Mean Achievement Scores of students taught Mathematics using Flipped classroom instructional strategy (FCIS) and those taught using Lecture method (LM)

Method	n	Pretest Mean	Pretest SD	Posttest Mean	Posttest SD	Mean gain

LECTURE	41	22.73	7.49	23.46	14.62	0.73
FCIS	45	24.89	6.51	56.98	8.83	32.09
Mean difference		2.16		33.52		31.36

From Table 1, mean pre-test and post-test scores of 22.73 and 23.46 were obtained for students taught with LM respectively, while mean pre-test and post-test scores of 24.89 and 56.98 respectively were obtained for students taught mathematics using FCIS. A mean gain of 0.73 was obtained for students taught with LM while a higher mean gain of 32.09 was obtained for students taught with FCIS. This indicates that students taught using FCIS achieved more than the students taught mathematics using LM. Also, the table further reveals that FCIS group has a lower post-test SD (8.83) than their counterparts in LM group (14.62) which indicates that the experimental group (FCIS) has a more homogenous scores in their post-test than the control group. The difference between the mean gained achievement scores of the students in both groups is 31.36 in favour of FCIS.

Research question 2: What are the differences in mean achievement scores of male and female students taught mathematics using FCIS and those taught using LM?

Table 2: Mean Achievement scores of male and female students taught Mathematics using Flipped classroom instructional strategy (FCIS) and those taught using Lecture method (LM)

Method	Gender	n	Pretest Mean	Pretest SD	Posttest Mean	Posttest SD	Mean Difference
LECTURE	Female	16	24.88	7.59	24.00	14.31	
	Male	25	21.36	7.25	23.12	15.00	0.88
FCIS	Female	24	25.74	6.59	59.13	10.07	
	Male	21	24.00	6.47	54.53	6.83	4.60

From Table 2, the post-test mean achievement score of male students, 24.00 is higher than the mean achievement score of their female counterparts, 23.12 taught mathematics with LM with mean difference of 0.88 in favour of the female students. Also, female students taught mathematics using FCIS had post-test mean of 59.13 while their male counterparts scored 54.53 with a mean difference of 4.60 in favour of the female students. In general, female students achieved higher than their male counterparts when taught mathematics using both LM and FCIS. Table 2 further reveals that in LM group, female students have a more homogenous score with a lower post-test SD of 14.31 against their male counterparts (15.00) while in FCIS group, male students have a more homogenous scores with post-test SD of 6.83 against their female counterparts 10.07.

Hypothesis 1: There is no significant difference in the mean achievement scores of students taught mathematics using flipped classroom instructional strategy (FCIS) and that of those taught using lecture method (LM).

Table 3: ANCOVA Test of significance of difference between the Mean Achievement Scores of students taught Mathematics using FCIS and those taught using LM.

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Decision
Corrected Model	24322.388[a]	3	8107.463	56.591	.000	
Intercept	135367.719	1	135367.719	944.886	.000	
Gender	145.805	1	145.805	1.018	.316	Not sig.
Method	23266.240	1	23266.240	162.402	.000	sig.
Gender * Method	64.841	1	64.841	.453	.503	Not sig.
Error	11747.612	82	143.264			
Total	180636.000	86				
Corrected Total	36070.000	85				

Table 3 reveals that, there is significant difference in the mean achievement scores of students taught mathematics using FCIS and that of those taught using LM, F (1, 86) = 162.402, P =0.000 < 0.05. Therefore, the null hypothesis is rejected meaning there is significant difference in the mean achievement scores of students taught mathematics using FCIS and that of those taught using LM.

Hypothesis 2: There is no significant difference in the mean achievement scores of male and female students taught mathematics using flipped classroom instructional strategy (FCIS) and that of those taught using lecture method (LM).

Table 4 further reveals that, there is no significant difference in the mean achievement scores of male and female students taught mathematics using FCIS and that of those taught using LM, F (1, 86) = 1.018, P = .316 > 0.05. Therefore, the null hypothesis is not rejected meaning there is no significant difference in the mean achievement scores of male and female students taught mathematics using FCIS and that of those taught using LM

Hypothesis 3: There is no significant interaction effect of instructional strategies (FCIS & LM) and gender on students' achievement in mathematics.

Table 5 also reveals that, there is no significant interaction effect of instructional strategies (FCIS & LM) and gender on students' achievement in mathematics, F (1, 86) = .453, P = . .503 > 0.05. Therefore, the null hypothesis is not rejected meaning there is no significant interaction effect of instructional strategies (FCIS & LM) and gender on students' achievement in mathematics.

VI. Discussion

The findings from the results revealed that significant difference exists in the students' achievement in mathematics with respect to the instructional strategies. FCIS was found to be more effective in improving students' achievement in mathematics. The increase in students' involvement in classroom activities would have accounted for the better performance of students in the flipped classroom group. This finding agreed with the findings of Sunday *et al*, (2021); Makinde (2019) and Ugwuoke, Edeh & Ezemma (2018) which reveals that there was a significant difference in pre-test - post-test scores in favor of the flipped classroom when comparing performance using offline Video CD recorded by the teacher with conventional classroom students.

Moreover, the result of this study showed that gender has no significant effect on students' achievement in mathematics. This implies that male and female students taught mathematics using FCIS and LM did not differ in their achievement. The result was in agreement with Ossai (2023); Amataobi and Amatobi (2020) and Musa & Samuel (2019), who concluded that there exists no significant difference in achievement of male and female students in mathematics. On the other hand, the result was in disagreement with the findings of Tarfa and Dike (2022), Yar'adua (2021) and Wordu and Iwok (2018), who found out that significant difference exists by gender on mathematics achievement of students. From this current study, one can deduce that gender has no influence on the achievement of students in mathematics. This implies that, using any good teaching strategy that male and female students will achieve equally.

Furthermore, the result showed that interaction effect of instructional strategies and gender on students' achievement scores in mathematics was not significant. In other words, the instructional strategies used in the study did not impart differently on male and female students based on their academic achievement in mathematics. This is inconsistent with the findings of Ogoke & Okigbo (2021); Chiakwelu & Okigbo (2020) and Wordu & Iwok (2018) who averred that gender and treatment have significant interaction effect on students' achievement in mathematics. However, the finding agrees with Eze (2023) and Okigbo & Anyanwumelu (2021) who concluded that there is no significant interaction effect of methods and gender on achievement in mathematics.

VII. Conclusion

Based on the findings of this study, it was concluded that teaching mathematics with FCIS is more effective than LM in improving students' achievement in mathematics. FCIS is also gender friendly as it improved achievement of both male and female students equally in mathematics.

VIII. Recommendations

Based on the findings, the following recommendations are made that:

1. Mathematics teachers in secondary schools should adopt the use of FCIS in teaching mathematics.
2. Curriculum planners should adopt FCIS as an innovative teaching strategy when reviewing mathematics curriculum.
3. Government should provide appropriate resource materials required to facilitate the use of flipped classroom in the secondary schools.
4. Students' mathematics teachers should be trained in their method class on the use of FCIS and FCIS by the teacher educators in tertiary institutions.

Acknowledgement

The researcher is much grateful to the supervisor, Prof. Okigbo E.C., and everyone that gave all the necessary correction and guidance that led to the completion of the study.

REFERENCES

[1] Agbasi, S. O., & Okeke, S. O.C. (2020). Effect of Reflective Instructional Strategy on Secondary School Students' Achievement and Interest in Chemistry in Awka Education Zone, Anambra State. *UNIZIK Journal of STM Education*, 3(2), 161-168.

[2] Allahnana, K. M., Akande, M. T., Vintseh, I. M. U., .Alaku, E. A., & Monica, E. A. (2018). Assessment of gender and interest in mathematics achievement in Keffi Local Government Area of Nasarawa State, Nigeria. *International Journal of Operational Research in Management, Social Sciences & Education | IJORMSSE,* 4 (1), 127-140.

[3] Amatobi, V. E & Amatobi, D. A. (2020). The influences of gender and attitude differences to students' achievement in mathematics in Nigerian secondary schools: a case study of Comprehensive Secondary School Amurie-Omanze in South Eastern Nigeria. *American Journal of Research Communication,* 8(2): 1-8. Retrieved on October 20, 2023 from www.usa-journals.com.

[4] Awodun, A. O. (2020). Effects of Reflective Teaching strategy on Students' Academic Performance in Secondary School Physics in Ekiti State, Nigeria. *International Journal of Scientific Development and Research,* 5(8), 470-476. Retrieved from www.ijsdr.org on December 17, 2022.

[5] Boris, O.O. (2019). Effects of reflective teaching on secondary school students' academic achievement in Chemistry in Ondo State Nigeria. *International Journal of Research and Analytical Reviews.* 6(3), 32-39.

[6] Chiakwelu A. B & Okigbo .E .C. (2020). Effect of jigsaw team-pair-solo reciprocal teaching strategies on secondary school students' achievement in mathematics in Onitsha education zone. *IOSR Journal of Mathematics (IOSR-JM)*, 16(1), 50-57. DOI: 10.9790/5728-1601045057.

[7] Eze .I .L. (2023). *Effect of Flipped Learning on Nigeria Certificate in Education (NCE) Mathematics Students' Interest and Achievement in Trigonometry in Kano State, Nigeria.* Retrieved October 10, 2023 from https://www.researchgate.net/publication/372273384_Effect_of_Flipped_Learning_on_Nigeria_Certificate_in_Education_NCE_Mathematics_Students'_Interest_and_Achievement_in_Trigonometry_in_Kano_State_Nigeria. DOI: 10.37745/bje.2013/vol11n87691

[8] Godpower-Echie, G., & Owo, W. J. (2019). Gender Differences in Basic Science Achievement of Private Junior Secondary School Students in Obio/Akpor Local Government Area, Rivers State. *International Journal of Scientific Research in Education*, 12(2), 320-329.Retrieved from http://www.ijsre.com.

[9] Gutiérrez, W.B. (2022). Learning Based On the Application of the Flipped Classroom Model In University Students. *Mendive* Vol. 20 (1) Retrieved from https://www.researchgate.net/publication/365476570, on 17 December, 2022

[10] Hayırsever, F. & Orhan, A. (2018). Ters yüz edilmiş öğrenme modelinin kuramsal analizi. *Mersin Üniversitesi Eğitim Fakültesi Dergisi*, 14(2), 572-596.

[11] Koh, J.H.L (2019, August). Four Pedagogical Dimensions for Understanding Flipped Classroom Practices in Higher Education: A Systematic Review. *Educational Sciences: Theory and Practice,* 19(4) 14 – 33.

[12] Lo, C.K. & Hew, K.F. (2017). Using 'first principles of instruction' to design secondary schoolmathematics flipped classroom: the findings of two exploratory studies. *Journal of Educational Technology and Society,* 20(1), 222-236, available at: www. jstor.org/stable/pdf/jeductechsoci.20.1.222.pdf

[13] Makinde, S.O. (2019*). Effects of a developed flipped classroom package on senior secondary School students' performance in mathematics in Lagos,Nigeria.* Retrieved on December 17, 2022, from https://www.researchgate.net/publication/334046113 DOI: 10.13140/RG.2.2.36614.01609

[14] Makinde, S.O. & Yusuf, M.O. (2019). *The Flipped Classroom: Its Effects on Students' Performaabiodunnce and Retention In Secondary School Mathematics Classroom.* Retrieved on December 17, 2022 from: https://www.researchgate.net/publication/334046424

[15] Musa, D. C., & Samuel, I. R. (2019). Influence of Gender and School Location on Science and Mathematics Students' Achievement in Western Senatorial District of Nasarawa State, Nigeria. *East African Scholars Multidisciplinary Bulletin,* 2 (8), 259-264. DOI: 10.36349/EASMB.2019.v02i08.001.

[16] Ogoke .J .C & Okigbo .E.C. (2021a). Effect of two modes of lesson study techniques on senior secondary school students' achievement in mathematics in Okigwe education zone two. *AJSTME,* 6(2), 68-78.

[17] Okigbo .E .C & Anyanwumelu .O. (2021). Effect of scaffolding instructional strategy on secondary school students' academic achievement in mathematics in Otuocha education zone. *Unizik Journal of Educational Research and Policy Studies,* 8, 52-60.

[18] Ossai, P. A. U. (2023). Gender variations in mathematics achievement in Nigerian post-secondary institutions. *Journal of Science Technology and Education,* 11(2), 121-126.

[19] Pi-Day. (2019). *10 reasons why mathematics is important to life.* Retrieved from https://www.piday.org/2018/10-reasons-why-mathematics-is-impotant-in-life/.

[20] Sunday, A. O., Abiodun, T. R. & Olaoye, A. E. (2021). *Effects of flipped classroom and reality pedagogy approaches on secondary mathematics students' achievement in Kuje, Federal Capital Territory, Nigeria.* Retrieved from: https://www.research gate.net /publication /351936428 on December 17, 2022.

[21] Tarfa, F. S. & Dike, C. O. (2022). Gender Differences in the Academic Performance of Students in Senior Secondary School Mathematics. *International Journal of Innovative Science and Research Technology.* 7 (3), 424-430.

[22] Ugwoke, E. O., Edeh, N.I. & Ezemma, J. C. (2018). Effect of Flipped Classroom on Learning Management Systems and Face-to-Face Learning Environments on Students' Gender, Interest and Achievement in Accounting. *Library Philosophy and Practice (e-journal).* 1875. Retrieved from http://digitalcommons.unl.edu/libphilprac/1875 on December 17, 2022.

[23] Wordu, H., & Iwok, U. A. (2018). Influence of Gender and Learning Environment on Students' Academic Achievement in Mathematics in Akwa Ibom State. *International Journal of Innovative Social & Science Education Research,* 6 (1), 30-37.

[24] Yakar, Z.I. (2021). The Effect of Flipped Learning Model on Primary and Secondary School Students' Mathematics Achievement: A Meta-Analysis Study. *Cukurova University Faculty of Education Journal,* 50 (2), 1329-1366. DOI: 10.14812/cufej.865337. December 17, 2022.

[25] Yar'adua, A. S. (2021). Comparative analysis of male and female students' academic performance among senior secondary school mathematics in Katsina State, Nigeria. *A paper presented at the 57th Annual Conference of the Mathematical Association of Nigeria (M.A.N),* held in B.U.K. from 29t h August - 3rd September, 2021.

[26] Zalmon, I.G. & Charles-Ogan, G.I. (2021). Polya's problem solving strategy and students' retention in calculus. *Journal of Education and Training Technology,* 10(1), 123-139.

[27] Zalmon, I.G. & Wonu, N. (2017). Comparative analysis of students Mathematics Achievement in West African senior secondary Certificate Examination in Nigeria. *European Journal of Research and Reflection in Educational Sciences,* 5(1), 24-31.

[28] Zalmon, I.G.(2021). *Effects of Polya's and Schoenfeld's problem solving strategy on Secondary Students' Performance and Retention in Mathematics in Obio-Akpor, Rivers State.* Unpublished Ph.D Thesis, University of Port Harcourt.