British Journal of Education, 13 (12), 104-117, 2025
Online ISSN: 2054-636X (Online)
Print ISSN: 2054-6351(Print)
Website: https://www.eajournals.org/
Publication of the European Centre for Research Training and Development-UK

Impact of Asynchronous Online Discussion On Under Graduate Mathematics Education Students Achievement and Retention in Topology Course

[1]John E. Eze, and [2] Ifeoma L. Eze
[1]Department of Mathematics Education
[2] Department of Computer Science Education, School of Secondary Education (Sciences) Federal College of Education (Technical), Bichi, Kano State

doi: https://doi.org/10.37745/bje.2013/vol13n12104117 Published December 04, 2025

Citation: Eze J.E., and Eze I.L. (2025) Impact of Asynchronous Online Discussion On Under Graduate Mathematics Education Students Achievement and Retention in Topology Course, *British Journal of Education*, 13 (12), 104-117

Abstract: *The primary aim of this study was to examine the effect of asynchronous online discussion on the achievement and retention of undergraduate Mathematics Education students in a Topology course. The research employed a quasi-experimental design, specifically a non-equivalent pretest-posttest control group design, in which intact classes were randomly assigned to either the experimental or control group. The study population comprised all 300-level undergraduate Mathematics Education students at the Federal College of Education (Technical), Bichi, Kano State, affiliated with Abubakar Tafawa Balewa University, Bauchi. To guide the investigation, four research questions and four corresponding hypotheses were formulated. Data were collected using a Topology Achievement Test (TAT) and a Topology Retention Test (TRT), both developed by the researcher and consisting of 40 multiple-choice items. The instruments were validated by specialists in Mathematics Education and Measurement and Evaluation, using a table of specifications. Reliability coefficients, computed with the Kuder-Richardson formula (KR-20), were 0.78 for the TAT and 0.69 for the TRT. The study was conducted over a 9-week period, during which the experimental group received instruction via asynchronous online discussion, while the control group was taught using the traditional lecture method. Collected data were analyzed using the Statistical Package for Social Sciences (SPSS). Descriptive statistics were used to answer the research questions, while Analysis of Covariance (ANCOVA) at a 0.05 significance level was employed to test the hypotheses. The findings have significant implications for mathematics educators in Nigeria, especially in the context of curriculum restructuring with a focus on concept attainment. Among the recommendations, the study suggests that asynchronous online discussion should be incorporated as a teaching method across all levels of the Nigerian educational system.*

Key words: asynchronous learning, achievement, retention, topology, instructional strategy

INTRODUCTION

The integration of computers and digital technologies has significantly enhanced the quality of modern teaching and learning. There has been a notable shift toward **e-discussion**, which leverages information and communication technologies (ICT) and the internet to support instructional delivery. E-discussion offers a flexible, accessible, and convenient mode of

learning, and many higher education institutions now use it to supplement or replace traditional face-to-face instruction, often in blended learning formats. Students of all ages and abilities benefit from the opportunity to learn anytime, anywhere, and at their own pace.

Asynchronous online discussion is a form of e-learning that occurs across different time frames, allowing participants to engage at their convenience through tools such as email, voice mail, and discussion forums. Interaction is delayed, often separated by minutes, hours, or days (Araújo, de Lima, Cidade, Nobre, & Neto, 2020). Research indicates that asynchronous discussions positively impact distance learning by enabling flexible interaction between learners and instructors, supporting self-paced access to course materials, and facilitating cognitive engagement and critical thinking (Erenita et al., 2022; Johnson, 2021). These discussions foster **collaborative learning**, enabling students to exchange knowledge, reflect on ideas, and co-construct understanding with peers from diverse backgrounds. This collaborative environment promotes higher-order thinking and the development of a critical learning community, enhancing both knowledge acquisition and practical application (Maria & Stephanie, 2021; Fjelstul, 2006; Erenita et al., 2022).

Academic achievement refers to the knowledge and skills acquired by learners within a specific period, such as a semester or study stage (Odeh & Makkawi, as cited in Adnan, 2018; Mutanu & Machoka, 2019). Achievement reflects learners progress and behavioral change and is a key factor considered by employers, particularly for fresh graduates in technology-related fields (Oladebinu, Amos & Oyediran, 2018). Several variables—including motivation, learning environment, and teacher experience—affect achievement levels (Fischer et al., 2018; Duckworth et al., 2019; Van Merriënboer & Kirschner, 2017; Kim, Brady & Wolters, 2020; Raymond et al., 2019; Scales et al., 2020; Bowman, 2019).

Retention is the ability to retain and recall learned knowledge over time. Effective learning requires meaningful engagement, as rote memorization often leads to poor retention and limited behavioral change (Alhassan et al., 2013). Interventions such as computer-aided instruction (CAI), enhanced orientation, personalized guidance, and early detection of at-risk students have been shown to improve retention (Rita, Katrina & Rebecca, 2018).

In the context of mathematics education, particularly in the **topology course**, traditional lecture-based methods dominate teaching practices, often resulting in poor student understanding and achievement (Onyishi & Agwagah, 2011). Students struggle with comprehension, fundamental principles, and logical reasoning when instruction is passive. Alternative teaching strategies, including problem-solving, discovery learning, e-discussion, cooperative learning, flipped classrooms, and concept mapping, have been developed to address these challenges. However, many teachers continue to rely on lectures, possibly due to familiarity or perceived simplicity, leading to suboptimal student outcomes.

This study focuses on evaluating the impact of online asynchronous discussion as an instructional strategy on the **academic achievement and retention** of undergraduate Mathematics Education students in the topology course. It also examines whether the approach differentially affects male and female students, aiming to determine the effectiveness of this

innovative strategy in enhancing understanding, engagement, and long-term retention in mathematics education.

Objectives of the Study

The main purpose of this study is to determine the impact of online asynchronous discussion on students' academic achievement and retention in topology course. Specifically, the study sought to:

1. Analyze the impact of online asynchronous discussion on undergraduate students achievement in topology and those taught with lecture method.
2. Find out the impact of online asynchronous discussion on the achievement of male and female undergraduate students in topology course.
3. Determine the impact of online asynchronous discussion on mean retention of undergraduate students in topology course.
4. Compare the impact of online asynchronous discussion on the mean retention of male and female undergraduate students in topology course.

Research Questions

The following research questions were formulated for the study.

1. What are the mean academic achievement scores of students taught topology using online asynchronous discussion and those taught with lecture method?
2. What are the mean academic achievement scores of male and female students taught topology using online asynchronous discussion and those taught with lecture method?
3. What are the mean retention scores of students taught topology using online asynchronous discussion and those taught with lecture method?
4. What are the mean retention scores of male and female students taught topology using online asynchronous discussion?

Hypotheses

The following null hypotheses were formulated to guide the study and were tested at 0.05 level of significance.

Ho_1: There is no significant difference in the mean achievement scores of students taught topology using online asynchronous discussion and those taught with lecture method.

Ho_2: There is no significant difference in the mean achievement scores of male and female students taught topology using online asynchronous discussion

Ho_3: There is no significant difference in the mean retention scores of students taught topology using online asynchronous discussion and those taught with lecture method.

Ho_4: There is no significant difference in the mean retention scores of male and female students taught topology using online asynchronous discussion

METHODOLOGY

Design of the Study

The study employed a nonequivalent group quasi-experimental research design, which involves assigning subjects to experimental and control groups using non-random criteria rather than randomization. In quasi-experimental designs, variations in the primary

independent variable occur naturally or non-researcher-induced, thereby approximating experimental conditions where some participants receive the intervention while others do not. This design was deemed suitable for the study because it allowed the use of **intact classes** as experimental and control groups, minimizing disruption to normal school schedules and institutional programs while maintaining the integrity of the educational process.

Population, Sample and Sampling Techniques

The population of the study comprised all forty-eight (48) 300-level undergraduate Mathematics Education students at the Federal College of Education (Technical), Bichi, Kano State, affiliated with Abubakar Tafawa Balewa University, Bauchi. The sample size was equal to the population, consisting of all 48 students registered in the Mathematics course MTH 322 (Topology I) during the second semester of the 2024/2025 academic session. Using purposive sampling, students were assigned into an experimental group of 25 students (18 males, 7 females) and a control group of 23 students (15 males, 8 females). A pilot study was conducted with 20 students (14 males, 6 females) randomly selected from the population but not included in the main study sample.

Instruments for Data Collection

The **instruments for data collection** were the Topology Achievement Test (TAT) and the Topology Retention Test (TRT), both developed by the researcher. The **TAT** was used to address Research Questions 1 and 2, while the **TRT** addressed Research Questions 3 and 4. Each instrument comprised 40 multiple-choice items with four alternatives (A, B, C, D). The **TAT** was administered at the end of the course to assess students' mastery of the MTH322 (Topology I) content, developed in accordance with the National Universities Commission (NUC) curriculum. The **TRT** was administered several weeks after the TAT to evaluate students' retention of the learned material.

Validation of the Instruments

The **TAT and TRT instruments** were subjected to **face and content validation** by three experts from Federal College of Education (Technical), Bichi two from the Department of Mathematics Education and one from the Measurement and Evaluation unit. A **table of specifications** was developed to guide the construction of test items and ensure content validity. The experts were provided with the study title, research questions and hypotheses, the NUC curriculum for undergraduate Mathematics Education, and the test blueprint for both TAT and TRT.

Reliability of the Instruments

The reliability of the TAT and TRT was determined through a trial test conducted on 20 third-year Mathematics Education students randomly selected from outside the study population. These students shared similar characteristics with the main study participants. The Kuder-Richardson Formula 20 (KR-20) was used to assess the internal consistency of the instruments. The reliability coefficients obtained were 0.78 for TAT and 0.69 for TRT, indicating acceptable reliability for both instruments.

British Journal of Education, 13 (12), 104-117, 2025
Online ISSN: 2054-636X (Online)
Print ISSN: 2054-6351(Print)
Website: https://www.eajournals.org/
Publication of the European Centre for Research Training and Development-UK

The Experimental Procedure

Prior to the start of the experiment, pre-tests were administered to both the experimental and control groups. Mathematics lecturers provided detailed training on Google Classroom and Google applications (Drive, YouTube, Google Search), totaling six hours, to familiarize students with the tools. Subsequently, the lecturer created a Google Classroom, which the experimental group joined. Asynchronous videos prepared by the lecturer were shared through the platform to ensure students came to class prepared. Notifications via text messages and emails were sent whenever new materials were posted, encouraging timely access.

The experimental group received instruction using the asynchronous online learning approach via Google Classroom, while the control group was taught through traditional methods without digital support. The intervention lasted nine weeks, followed by a revision week in the 10th week, after which a post-test was administered to both groups. A re-test was conducted four weeks later to assess retention. The pre-test questions were reused for the post-test and re-test, with items re-numbered to reduce recall bias.

DATA ANALYSIS

The collected data were analyzed using the **Statistical Package for Social Sciences (SPSS)**. **Research questions** were addressed using **mean and standard deviation (SD)**, while **hypotheses** were tested at the 0.05 level of significance using **Analysis of Covariance (ANCOVA)**. ANCOVA was deemed appropriate because it allows for the **adjustment of initial differences between groups**, which is essential given the pre-test and post-test design involving intact classes. Additionally, ANCOVA facilitates the **comparison of group means**, enabling a more accurate assessment of the effect of the treatment on the dependent variable.

PRESENTATION OF RESULTS

Research Question One

What are the mean academic achievement scores of students taught topology using online asynchronous discussion and those taught with lecture method?

The data for answering research question one is presented in Table 1 below.

Table 1: **Pre-test and Post-test Mean Academic Achievement Scores of Students Taught Topology using Asynchronous Online Learning and those taught using lecture Method**

	Pre-test			Post-test		
Groups	**N**	$\bar{x}$	**SD**	$\bar{x}$	**SD**	**Mean Gain**
Asynchronous	25	22.24	6.08	43 .41	8.54	21.17
Lecture Method	23	20.18	4.03	32.27	5.45	12.17

The results in Table 1 indicate that the pre-test mean achievement scores for the asynchronous and lecture groups were 22.24 (SD = 6.08) and 20.18 (SD = 4.03), respectively, showing that both groups had comparable achievement levels before the intervention. Following the

treatment, the post-test mean scores were 43.41 (SD = 8.54) for the asynchronous group and 32.27 (SD = 5.45) for the lecture group. The mean gain scores of 21.17 for the asynchronous group compared to 12.17 for the lecture group suggest that asynchronous online discussion was more effective in improving students' achievement in the topology course.

Research Question Two

What are the mean academic achievement scores of male and female students taught topology using online asynchronous discussion and those taught with lecture method?

The data for answering research question three are presented in Table 3 below.

Table 2: Pre-test and Post-test Mean Scores of Male and Female Students exposed to Asynchronous online learning and Lecture Method

Gender	Asynchronous					lecture Method				
	N	Pre-test		Post-test		Mean Gain	N	Pre-test		Post-test		Mean Gain
		x̄	SD	x̄	SD			x̄	SD	x̄	SD	
Male	18	35.02	9.04	60..21	12.56	25.09	15	23.62	4.56	62.64	5.60	39.02
Female	7	20.12	5.00	46.54	10.54	26.42	8	22.09	5.61	50.40	7.86	31.31

Table 2 shows that while female students in the same group had a pre-test mean of 20.12, a post-test mean of 46.54, and a mean gain of 26.42, male students taught topology via asynchronous online learning had a pre-test mean score of 35.02, a post-test mean score of 60.21, and a mean gain of 25.09. Male students in the lecture group had pre-test means of 23.62, post-test means of 62.64, and mean gains of 39.02, whereas female students had pre-test means of 21.09, post-test means of 52.40, and mean gains of 31.31. Both teaching strategies improved student achievement, as evidenced by the fact that post-test results were always higher than pre-test results. Male students performed better than female students in both groups, indicating that asynchronous online learning improved male students' academic performance in the topology course more than it did female students'.

Research Question three

What are the mean retention scores of students taught topology using online asynchronous discussion and those taught with lecture method?

The data for answering research question three is presented in the Table below.

Table 3 : Retention Mean Scores of Students Taught Topology using Asynchronous Discussion and those Taught using Lecture Method

Group	Gender	Retention x̄	N	SD
Treatment	Male	65.72	18	12.968
	Female	59.30	7	8.866
Control	Male	58.75	15	6.041
	Female	49.33	8	10.184

The results in Table 3 suggest that male students taught topology utilising asynchronous conversation got a mean retention score of 65.72, whereas their female counterparts scored

British Journal of Education, 13 (12), 104-117, 2025
Online ISSN: 2054-636X (Online)
Print ISSN: 2054-6351(Print)
Website: https://www.eajournals.org/
Publication of the European Centre for Research Training and Development-UK

59.30. In comparison, male students in the lecture group had a mean retention score of 56.65, and female students scored 44.23. Overall, students taught using asynchronous conversation displayed superior retention levels than those taught via the lecture method. This finding implies that asynchronous conversation is more effective in boosting the recall of topological concepts among undergraduate Mathematics Education students compared to the traditional lecture technique.

Research Questions Four

What are the mean retention scores of male and female students taught topology using online asynchronous discussion?

The data for answering research question four are presented in Table 4 below.

Table 4: Post-test and Retention-test mean scores of Male and Female Students Exposed to Asynchronous Online Learning and Lecture Method

Gender	Asynchronous					Lecture Method				
	N	Post-test	Retention-test		Mean Gain	N	Post -test	Retention-test		Mean gain
		x̄	SD	x̄	SD		x̄	SD	x̄	SD	
Male	18	60.21	11.54	72.23	7.75	12.02	15	62.64	5.60	68.45	9.91	5.81
Female	7	46.24	8.23	56.42	5.60	10.18	8	50				

The results in Table 4 demonstrate that male students taught topology via asynchronous online learning acquired a post-test mean score of 60.21 and a retention-test mean of 72.23, resulting in a mean gain of 12.02. Female students in the same group had a post-test mean of 46.24 and a retention-test mean of 56.42, with a mean gain of 10.18. In the lecture group, male students scored 62.64 on the post-test and 68.45 on the retention exam, with a mean gain of 5.81, whereas female students scored 50.40 and 54.20, with a mean gain of 3.80. Across all groups, retention-test scores were generally lower than post-test scores; however, male students in the asynchronous online learning group exhibited the highest mean gain, indicating that asynchronous online learning significantly enhanced retention in topology, particularly among male students compared to their female counterparts.

Hypotheses

Hypothesis One

Data for testing research hypothesis 1 is presented in table 5

Ho_1: There is no significant difference in the mean achievement scores of students taught topology using online asynchronous discussion and those taught with lecture method.

British Journal of Education, 13 (12), 104-117, 2025
Online ISSN: 2054-636X (Online)
Print ISSN: 2054-6351(Print)
Website: https://www.eajournals.org/
Publication of the European Centre for Research Training and Development-UK

Table 5: Two Way ANCOVA for difference in Achievement of Students Taught Topology using Asynchronous Discussion and those Taught with Lecture Method

Sources of Variation	Sum of Squares	Df	Mean Square	F	Sig.	Decision	Dec
Corrected Model	2154.312[a]	2	1072.703	9.980	.000		
Intercept	34730.040	1	34730.040	330.582	.000		
PRETEST	56.954	1	56.956	0.516	.475		
GROUP	1862.674	1	1862.674	17.096	.000	S	s
Error	7362.786	46	107.384				
Total	276772.000	48					
Corrected Total	9427.300	47					

a. R Squared = .240 (Adjusted R Squared = .206) S = Siginificant

Table 5 demonstrates a statistically significant difference in the mean achievement scores between students taught topology via asynchronous online discussion and those taught using the lecture technique. The analysis revealed F(1, 46) = 17.096, p = 0.000, which is less than the 0.05 significant level. Consequently, Hypothesis 1, which posited no significant difference in the mean achievement scores between the two groups, is rejected. This research reveals that students exposed to asynchronous online conversation got considerably higher mean scores in topology compared to their counterparts taught through the standard lecture technique.

Hypothesis Two

Ho_2:There is no significant difference in the mean achievement scores of male and female students taught topology using online asynchronous discussion

Data for testing research hypothesis 2 is presented in table 6

Table 6: Two Way ANCOVA for difference in Achievement of Students based on Gender and Method

Sources of Variation	Sum of Squares	Df	Mean Square	F	Sig.	Decision
Corrected Model	3170.512[a]	4	720.126	8.565	.000	
Intercept	23402.658	1	23402.658	225.512	.000	
PRETEST	81.238	1	81.238	.744	.387	
GROUP	1507.306	1	1507.306	15.854	.000	
GENDER	1088.465	1	1088.465	11.425	.102	NS
GROUP * GENDER	.640	1	.540	.008	.834	**NS**
Error	6134.674	44	84.533			
Total	276772.000	48				
Corrected Total	9425.200	47				

a. R Squared = .486 (Adjusted R Squared = .463) NS = Not Significant

Table 6 demonstrates that there was no statistically significant difference in the post-test mean scores of male and female students taught topology using asynchronous conversation, as F(1, 44) = 11.425 and p = 0.102, which is greater than the 0.05 significance level. This means that male pupils did not surpass their female counterparts in topological achievement. Consequently, Hypothesis 2, which hypothesized that there would be no significant difference in the mean achievement scores of male and female students taught topology via asynchronous conversation, is validated.

Hypothesis Three

Ho_3: There is no significant difference in the mean retention scores of students taught topology using online asynchronous discussion and those taught with lecture method.
Data for testing research hypothesis 3 is presented in table

Table 7: Two way ANCOVA difference in the Mean Retention Score of Students Taught Topolgy Using Asynchronous Discussion and those Taught with Lecture Method.

Sources of Variation	Sum of Squares	Df	Mean Square	F	Sig.	Dec
Corrected Model	3467.025[a]	2	2233.517	29.180	.000	
Intercept	730.816	1	730.816	10.001	.002	
RETENTION	2359.579	1	2359.579	31.885	.000	
GROUP	2065.255	1	2065.255	26.033	.001	S
Error	4946.166	46	63.002			
Total	276762.000	48				
Corrected Total	9435.200	47				

a. R Squared = .240 (Adjusted R Squared = .205)

Table 7 demonstrates a significant difference in the mean retention scores of students taught topology utilizing asynchronous online discussion compared to those taught using the lecture approach, with F(1, 46) = 26.033 and p = 0.001, which is less than the 0.05 significance level. Therefore, Hypothesis 1, which predicted that there would be no significant change in the mean pre-test and post-test retention scores between the two groups, is rejected. This suggests that students taught topology using asynchronous online conversation had considerably superior retention scores than those taught using the lecture method.

Hypothesis Four

Ho_4: There is no significant difference in the mean retention scores of male and female students taught topology using online asynchronous discussion
Data for testing research hypothesis 4 is presented in table 8

British Journal of Education, 13 (12), 104-117, 2025
Online ISSN: 2054-636X (Online)
Print ISSN: 2054-6351(Print)
Website: https://www.eajournals.org/
Publication of the European Centre for Research Training and Development-UK

Table 8: Two way ANCOVA difference in the Mean Retention Score of Male and Female Students Taught Topology Using Asynchronous Discussion

Source of Variation	Sum of Squares	Df	Mean Square	F	Sig.	
Corrected Model	3765.096[a]	4	1216.753	15.312	.000	
Intercept	881.767	1	881.767	14.024	.000	
RETENTION	1775.832	1	1775.832	23.797	.000	
GROUP	1223.303	1	1223.303	17.802	.000	
GENDER	327.901	1	327.901	5.125	.026	NS
GROUP * GENDER	68.544	1	68.544	1.112	.292	
Error	4550.102	44	60.003			
Total	276763.000	48				
Corrected Total	8426.200	47				

a. R Squared = .960 (Adjusted R Squared = .959)

Table 8 demonstrates that there is no significant difference in the mean retention scores of male and female students taught topology utilising asynchronous online conversation, with F (1, 44) = 5.125 and p = 0.026 > 0.05. Consequently, Hypothesis 4, which predicted that there would be no significant difference in the mean retention scores between male and female students in the asynchronous discussion group, is sustained. This means that both male and female students profited equally from asynchronous online conversation in terms of retention. The inference derived is that gender did not significantly affect retention outcomes among undergraduate students taught topology through this method.

FINDINGS OF THE STUDY

The following are the primary findings of the study.

1. The conclusion of the study demonstrated that asynchronous online conversation increased students academic progress in topology than the lecture method.
2. The findings of the study showed that there was a significant difference in the mean academic success score of students taught topology utilising asynchronous online discussion than those taught with lecture technique.
3. The findings of the study suggest that asynchronous online conversation increased students' retention in topology than the lecture technique.
4. The findings of the study showed that there was a significant difference in the mean retention score of students taught topology utilising asynchronous online discussion and those taught with lecture approach.
5. The findings of the study demonstrated that asynchronous online conversation increased male students academic progress in topology than their female counterparts.
6. The findings of the study demonstrated that there was no significant difference in the mean achievement scores of male and female undergraduate students taught topology via asynchronous online conversation.

7.The findings of the study demonstrated that asynchronous online conversation increased male students' retention scores in topology than their female counterparts.

8. The findings of the study demonstrated that there was no significant difference in the mean retention scores of male and female undergraduate students taught topology via asynchronous online conversation.

DISCUSSION OF THE FINDINGS

The findings of the study are discussed according to the research questions answered and hypotheses tested.

Impact of Asynchronous Online Discussion on Students Academic Achievement in Topology

The study results reveal that students taught topology using asynchronous online discussions got higher mean scores than those taught via the lecture technique. A substantial difference was detected in the mean accomplishment scores, favoring the asynchronous group. This success can be linked to the tailored learning possibilities provided through online instructional films and Google Classroom activities, which fostered self-paced learning and active engagement. These findings correlate with past studies indicating the positive impact of asynchronous learning on student progress (Fjelstul, 2006; Erenita et al., 2022; Bali, 2016). The benefits of asynchronous online discussions include flexibility in time and location, support for student-centered learning, opportunity for self-assessment, higher-order thinking, and inclusive, egalitarian learning settings.

Level of Achievement based on Students gender exposed to Topology using Asynchronous Online Discussion

The study indicated that asynchronous online conversation boosted male students academic achievement slightly more than that of female students, although the difference was not statistically significant. This suggests that gender did not significantly influence mean achievement results in the topology course. The outcome may be attributable to the equal learning chances provided to both male and female students inside the asynchronous online learning environment. These findings are consistent with Charles-Ogan (2014), who reported similar performance levels among male and female students with mathematics disabilities, and align with the conclusions of Ibenegbu & Ugwu (2022) and Ezeudu & Gbendu (2021), who argued against gender-based differences in academic ability.

The level of retention based on Students gender exposed to topology using Asynchronous Online Discussion.

The findings suggested that asynchronous online conversation somewhat enhanced male students' retention scores in topology compared to their female counterparts. However, the difference was not statistically significant, demonstrating that gender had no major effect on students' retention. This suggests that both male and female students retained content from the topology course equally well when taught utilizing asynchronous online conversation, indicating that no gender discrepancy exists in retention within this instructional context.

CONCLUSION

The continuous poor academic performance and deteriorating quality of Nigerian graduates remain a key worry for educators and stakeholders, despite advances in information and communication technologies in teaching and learning. Recognizing the potential of computer-mediated communication in higher education, this study explored the influence of asynchronous online conversation on undergraduate students' achievement and retention in a topology course. The data indicate that asynchronous online learning is more successful than the traditional lecture method in boosting both academic achievement and retention. The superior performance observed in the asynchronous group is attributed to features such as self-paced learning, flexibility, virtual engagement, increased mentoring, opportunities for higher-order thinking, and inclusive, equitable participation, all of which actively involve students in the learning process.

Recommendations

Based on the findings of the study, the following recommendations were made.

1. Asynchronous online Discussion should be employed as a medium of instruction at all levels of the Nigerian educational system as part of their teaching methodologies.
2. Instructional materials to assist effective teaching and learning with the application of these modern teaching strategies should be given by the government and school authorities.
3. Seminars, workshops and conferences should be organized by the Nigerian University Commission(NUC) in collaboration with the Ministry of Education where lecturers, institutions administrators, and students will be trained on how to make effective use of asynchronous online discussion in their day-to-day teaching and learning activities
4. The Federal and State governments through the Ministry of Education should provide ICT infrastructure and resources adequately to introduce asynchronous online Discussion at all tertiary institutions in Nigeria.
5. The National Universities Commission (NUC) should undertake a reform of the Mathematics Education curriculum to incorporate asynchronous online Discussion in the teaching of mathematics courses.

REFERENCES

Adnan, S.A. (2018). The relationship between self-esteem and academic achievement in the scientific concepts and methods of teaching course among female students of the class- teacher at the University of Jordan modern applied science. Canada: Canadian Center of Science and Education. Retrieved on 26th Feb. 2020. From: *https://doi.org/10.5539/mas.v12n2p164.*

Akinbobola, A. O., and Afolabi, F. (2010). Analysis of science process skills in West African senior secondary school certificate physics practical examinations in Nigeria. *American-Eurasian Journal of Scientific Research, 5*(4), 234-240

Alhassan, D.S., Victoria, I.E., and Danteni, I.W. (2013). Effects of computer assisted instructional package on Junior secondary school students achievement and retention in geometry in Minna, Niger State, Nigeria. *International Journal of Humanities and Social Science Invention, 2(5),* 69-74.

Araújo, F. J. d, Lima, L. S. A., Cidade, P. I. M., Nobre, C. B., and Neto, M. L. R.

(2020). Impact of Sars-Cov-2 and Its Reverberation in Global Higher Education and Mental Health. Psychiatry Research, 288, 112977. doi:https://doi.org/10.1016/j.psychres.2020.112977

Bali, M. (2016). Bringing out the human in synchronous and asynchronous media for learning. In W.Kilgore, (Ed.), Humanizing online teaching and learning.

Beckwith, E.G. (2020). The importance of synchronous sessions in online asynchronous classes. In C. M. Sistek-Chandler (Ed.), *Exploring online learning through synchronous and asynchronous instructional methods (*pp. 34-51).

Bowman, N. A. (2019). Four Critical Years: Effects of College on Beliefs, Attitudes, and Knowledge by Alexander W. Astin. *Journal of College Student Development*, *60*(2), 245-249.

Charles-Ogan, G. (2014). Metagognitve strategy and senior secondary school Mathematics Students misconceptions in Rivers state. *Journal of Mathematical Association of Nigeria(JMAN).*39(1), 234 — 246.

Duckworth, A. L., Taxer, J. L., Eskreis-Winkler, L., Galla, B. M., & Gross, J. J. (2019). Self-control and academic achievement. *Annual Review of Psychology*, *70*, 373-399.

Erentia,V. B, Bernie,C,P, Joseph, J.S., Edward, B.B,, Hyacinth, C.G., Wilfred, J.A. & Bonard, B.T(2022).Asynchronous Learning Attittudes and mental health status amomg Math Majors. International *Journal of research and innovation in social science (URISS). 6 (8) , 76- 91*

Ezeudu, S.A & Gbendu, G. O. (2021). Effect of flipped classroom strategy on students attitude towards secondary school geography: implications for entrepreneurship education in Nigeria. *International Journal of Studies in Education*. 16(2), 38-51

Fjelstul, J. (2006). The impact of online education on Academic performance for Ladies Professional golf Association teaching and club Professional. Electronic Theses and Dissertations, 2014-2019. 760.*htps ://Stars.library.ucf.edu/etd/760*

Ibenegbu, C.I. & Ugwu, K. (2022). Effects of Flipped Classroom Approach on Students Achievement in Government in Nsukka Education Zone, Nigeria. Available online at DOI: https://doi.org/10.21203/rs.3.rs-1633688/v1

Fischer, F., Hmelo-Silver, C. E., Goldman, S. R., & Reimann, P. (Eds.). (2018). *International Handbook of the Learning Sciences*. New York, NY: Routledge.

Johnson, S.M., (2021). *Interacting Asynchronously. Online Course Development Resources*. Vanderbilt University Center for Teaching.

Kim, Y. E., Brady, A. C., & Wolters, C. A. (2020). College students' regulation of cognition, motivation, behavior, and context: Distinct or overlapping processes?.*Learning and Individual Differences*, 101872.

Mutanu, L., &Machoka, P. (2019). Enhancing Computer Students Academic Performance through Predictive Modelling-A Proactive Approach. In *2019 14th International Conference on Computer Science & Education (ICCSE)* (pp. 97-102). IEEE.

Oladebinu, A., Amods, E. &Oyediran, C.F. (2018). Factors affecting students academic performance in colleges of education in Southwest. *Nigeria British Journal of Education 6(10); 43-56.*

Onyishi, E.U & Agwagah, U.N.V(2011). Improving the Teaching and the learning of mathematics through the use of mind map for the attainment of Millennium development Goal. *Abacus, The Journal of Mathematical association of Nigeria.36(1), 27-34.*

Raymond, M.V. & MacIvor, E. (2019). Assessing the efficacy of incorporating game dynamics in a learning management system. Journal of Information Systems Education, 26(1); Available at *https://aisel.aisnet.org/jise/vol26/iss1/6*

Rita, G., Katrina, F. & Rebecca, V. (2018). Systematic literature review: Self-Regulated Learning strategies using e-learning tools for Computer Science. Retrieved on June 10, 2019. From: *https://doi.org/10.1016/j.compedu.2018.05.006*

Scales, P. C., Pekel, K., Sethi, J., Chamberlain, R., & Van Boekel, M. (2020). Academic Year Changes in Student-Teacher Developmental Relationships and Their Linkage to Middle and High School Students Motivation: A Mixed Methods Study. *The Journal of Early Adolescence*, *40*(4), 499-536.

Van Merriënboer, J. J., & Kirschner, P. A. (2017). *Ten steps to complex learning: A systematic approach to four-component instructional design*. Routledge.

TETFUND SPONSORED 2022-2024 BATCH 13