

# EFFECT OF DISTANCE ASYNCHRONOUS INSTRUCTIONAL STRATEGY ON ACADEMIC PERFORMANCE OF SCIENCE SECONDARY SCHOOL STUDENTS IN ORGANIC CHEMISTRY CONCEPT IN KANO METROPOLIS

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## Abstract

The researcher investigated the effect of distance asynchronous instructional strategy on academic performance of science secondary school students' organic chemistry, was studied, using quasi pre-test, post-test experimental and control design, a sample size of one hundred and eighty two (182) SSII students were used from a population of two thousand one hundred and seventy five (2175). One validated Instrument: Organic Chemistry Achievement Test, (OCAT) with a reliability coefficients of 0.91 was used for data collection. Data collected were analysed using mean and standard deviation for the research questions and ANCOVA inferential Statistics was used for testing the hypotheses at 0.05 level of significance, the findings revealed that (i) The experimental group taught using distance asynchronous instructional strategy performed better than the control group taught using conventional lecture method; ( $F(2, 179) = 139.99, P = 0.000$ ) (ii) Male and female students taught using distance asynchronous strategy did not perform significantly different in their academic performance ( $F(2, 90), P = 0.091$ ). It can be concluded that distance asynchronous instructional strategy was effective in improving student performance. It was recommended that distance asynchronous strategy should be incorporated into the science teacher training curriculum by the Ministry of Education to produce teachers who would handle asynchronous instructional strategy effectively to augment normal classes in season of pandemic.

**Keywords:** Asynchronous; Organic Chemistry; Distance Learning

## Introduction

Education has been the pillar of development in the universe, the light of civilization in the world, the fuel of harmonization, across continents, the booster of economy of nations, the principal development and growth of all countries. The education system has been affected by several challenges, the deadliest was the closing down of the educational sector due to widespread pandemic diseases (Bhandari, 2022). The world Health Organization (W.H.O.) in 2020 declared COVID-19 in March 2020 as a global pandemic, in other to minimizing the spread of the virus, various governments established, curfew and lockdown, in workplace, suspension of transport facilities and so on, educational institutions was temporarily closed down by most countries around the world Nigeria inclusive (Dan-Nwafor, Ochu, Elimian, Oladejo, Ilori, Umeokonkwo & Ihekweazu (2020). Over 90 per cent student population of the world were affected by the structure of teaching, learning and assessment nationwide. (Tarkar, 2020) Online technology teaching methods were adopted by the few private schools in Nigeria, while lowincome government owned institutions were completely closed, without access to digital learning and these have disrupted the learning of students (Eze, Sefotho, Onyishi, & Eseadi, 2021). However, many countries had to change the shape of education fast to online or offline digital or electronic

learning platforms, which became the only mode of teaching, due to the pandemic secondary schools were incorporated to distance learning, which was formally for higher education (Ali, 2020).

In this regard, distance education can be viewed as an independent learning practice in which teachers and students are not bound to time and space. In distance education, a student doesn't have to go to school, learners are responsible for their own learning processes, with the help of technology, studies on distance education have stepped up and have become more popular lately (Eygü & Karaman, 2013). The use of technology has helped greatly in effective execution of digital learning. As a result, teachers modify lesson plans and instruction to fit an online/offline asynchronous distance learning setting (Zalat, Hamed & Bolbol, 2021).

Asynchronous instructional strategy, can be seen as a method or digital teaching strategy in which students learn a task which is before them or accessed course material, at different location, time and environment, it's create a platform that enables teachers to interact with their students outside the confine enclosure of the conventional classroom. It does not require consistent real-time interactions with an instructor. It uses resources that facilitate information sharing outside the constraints of time and place among a network of people (Fabriz, Mendzheritskaya, Stehle, 2021). Students don't need to study simultaneously in the same physical classroom or online learning environment. It allows students to decide their learning style and pace, but it frequently requires the completion of the syllabus by a specific deadline. Anytime students enrolled in an online course, watch a YouTube instruction or prerecorded video or listened to audio of teaching, they have engaged in asynchronous learning (Thomson, 2010). At home watching recorded lessons or lectures can help students with deeper independent understanding to recall what was taught (Zainuddin & Halili, 2016). It offers the students the opportunity to learn at their own pace, to become familiar, with the key lessons, return to past lessons or lectures to review something they might have missed. The growth of internet-based technology gave asynchronous learning a boost. The difficulties that the pandemic caused for educators, students, and parents accelerated innovation in education at an unprecedented rate and scale, making asynchronous learning to gain a lot of popularity (Foertsch, Moses, Strikwerda & Litzkow, 2002; Kundu & Bej, 2021).

Among numerous benefits of asynchronous instructional strategy, students may be able to watch videos introducing crucial concepts repeatedly as needed in online asynchronous classes, which may result in permanent retention, in specific courses, students can finish their homework and get feedback. Any student enrolling in an asynchronous course is obligated to work one week at a time, just like a student in a classroom. With minimal time constraints, students can practice at their speed and learn the essential abilities ahead of them. The trajectory of student's entire work lies from the safety and comfort of their home. Students will not waste their time learning topics they already know they will skip quickly to the ones they don't know Jackson, Bradbury-Jones, Baptiste, Gelling, Morin, Neville, & Smith (2020). Asynchronous instructional learning example in consumer-facing platforms are Khan Academy, Udemy, Coursera, and Pluralsight.

**Asynchronous processes include, watching lectures or sessions that have already been** pre-recorded, video lectures, educational videos, audio tutorials, that have been recorded separately and then circulate to students. Many students can utilize these, pre-recorded courses materials because they engage them in the learning process at a minimal cost (Almendingen, Morseth, Gjølstad, Brevik, & Tørris, 2021). It enables students to find learning more engaging and active in learning science.

Science helps to answer great mysteries about the existence of human. It is a great enterprise which nations depend on, in-order to advance in technologically. Science has helped in propelling the economic status of every nation. It offers solutions to social, agricultural and environmental problems, promotes industrial development, and works cooperatively to raise peoples' standards of living (Goodwin, 2010). Its study is now required as a fundamental strength in educational institutions all around the world. Science education guidelines and standards suggest that proficiency in science is achieved through learner-centered science instruction that supports conceptual understanding and provides opportunities to learn science subject, like chemistry which is often called central science, between biology and physics, and is a prerequisite subject for many fields of learning. It contributes immensely to the technological growth of the nation, in the field of medicine, forestry, agriculture, biotechnology and nursing. (Olumirin, Babalola, & Ayoola, 2022). The study of chemistry in senior

secondary school equip students with useful concepts, techniques, principles and theories that will enable them to become independent and counterproductive to the society (Millar, 2004). A branch in chemistry that plays an important part in our daily life in the production of food, clothes, paper, ink, rubber, mobile phones, cars, laptops soap, perfumes and medicines, and so on which are indispensable to us for proper living is periodically called organic chemistry.

Organic chemistry is important because it is the study of life and all of the chemical reactions related to life. Several careers apply the knowledge and understanding of organic chemistry, such as doctors, veterinarians, dentists, pharmacologists, chemical engineers, and chemists to solve problems (Akani, 2015). The study of organic chemistry cannot only be achieved through face to face interaction but also through distance asynchronous instructional strategy setting.

Highly organized asynchronous instructional learning strategy is structured around constructivist theory, because it is a student-centered approach that emphasizes self-study with asynchronous interactions to promote understanding. Constructivist teaching particularly is based on the belief that learning occurs as learners are actively involved in a process of learning (Bhattacharjee, 2015). Constructivist approach gives student the duty of being active during learning process it gives teachers the mission of organizing the teaching process as a facilitator guiding students, in asynchronous distance learning (Maor, 2003). Due to the covid-19 pandemic, where face to face teaching is not feasible, many schools resorted to distance learning where digital and online technology were used to teach, students. In this study the researcher studied the effect of distance asynchronous organic chemistry on learning performance of students, using digital devices.

### **Objectives of the Study**

The following objectives were raised which is to:-

1. ascertain the extent of distance asynchronous instructional strategy on organic chemistry student performance when compared with conventional, face to face instructional method
2. determine the difference in academic performance between male and female when taught organic chemistry using distance asynchronous instructional strategy.

### **Research Questions**

1. RQ<sub>1</sub>: What is the mean difference in performance scores between students taught organic chemistry using distance asynchronous instructional strategy and conventional face to face lecture?
2. RQ<sub>2</sub>: What is the mean difference between the performance score of male and female students taught organic chemistry using distance asynchronous instructional strategy?

### **Hypotheses**

The following hypotheses were raised

1. HO<sub>1</sub>: There is no significant difference between performance scores of students taught organic chemistry using distance asynchronous instructional strategy and those taught using conventional face to face lecture
2. HO<sub>2</sub>: There is no significant difference between performance scores of male and female students taught organic chemistry using distance asynchronous instructional strategy

### **Methodology**

The research adopted quasi pretest posttest experimental and control research design was used for the study. The population was two thousand one hundred and seventy five (2,175) and it comprises of all the six science and technical secondary schools (SSII) chemistry students in Kano state metropolis. Four schools, were selected randomly from the six, out of which two (2) were female and two (2) male schools, due to the nature of data needed to test the student achievement and gender, public science schools in Kano are not co-educational. One intact class was purposively sample and selected from each of the four selected schools, one male and female intact class was placed for experimental group (42 male; 48 female) and the remaining one male and female intact class was placed on control group (45 male; 47 female). The total in the experimental group was ninety (90) student, bearing in mind that the parent of this students have at least one of the following;

Light Emitting Diode Television (LED TV), Tablets, smartphones, Computers (Desk and Laptop), Digital Video Disc (DVD) player, Compact Disc (CD) Internet connectivity at home, with the conviction that they represent the characteristics of the target population, making the total sample size of one hundred and eighty two (182). The students in both group were pre tested using Organic Chemistry Achievement Test (OCAT), the control group were taught organic chemistry concepts for five weeks and the post test was administered at the end of the treatment, and the result recorded and stored. The last week before schools were to be on holiday, the researcher gave students in the experimental group, pre -recorded, organic chemistry concepts, on tapes and DVD, CD, flash drive, HDD, and online youtube links, where instructors taught organic chemistry, each of the organic concept was structurally frame, and breakdown on what to learn per week, objectives were drawn; the researcher who is the instructor presented, his email, phone number and WhatsApp detail for communication, he also had list of all the students with their contact detail on a WhatsApp group. The students went home during the holidays; to study, there was interaction between the instructors and students during the holiday. Immediately the experimental students resumes from the break to school, the researcher administer the post and the data recorded.

For data collection, Organic Chemistry Achievement Test was used. The OCAT was a performance test adapted from West African Examination Council (WAEC). The OCAT contains thirty (30) structures multiple choice items with one correct answer and three distractors. The OCAT was used for both pretest and post-test. The pre-test was conducted/administered to ascertain the ability of the students before the treatment which the scores was used for analysis. The instruments was given to panel of experts, which comprised of a professor, two senior lecturers, two science educators in test and measurement, two secondary schools teachers their input was used to improve the quality of the instrument. The OCAT was pilot tested with twenty four (24) students, outside the sample size and analyzed with Pearson Product Moment Correlation coefficient (PPMC) and a reliability coefficient of 0.91 was obtained the data was analyzed using mean, and standard deviation, for research questions while Covariate ANCOVA inferential statistics was used for hypotheses testing, at 0.05 alpha level of significance.

## Results

Research Question One: What is the mean difference in performance scores between students taught organic chemistry using distance asynchronous instructional strategy and conventional face to face lecture?

In order to answer the research question, table 1 shows the mean and standard deviation of the post test scores of OCAT;

**Table 1: Means and Standard Deviations of Students' Scores of Post Test OCAT**

Group	Mean	Std. Deviation	N
Asynchronous	69.33	10.271	90
Face to face lecture method	62.14	13.250	92
<b>Total</b>	<b>65.69</b>	<b>12.375</b>	<b>182</b>

Table 1, shows that the mean achievement performance score of experimental group students is 69.33 while that of the control group was 62.14 It would appear from the difference in the mean scores that experimental group students scored higher in the OCAT than the control. In order to ascertain whether this observed difference is real or attributed to error variance, the post test and the pre-test scores of the OCAT was subjected to inferential statistics testing, at 0.05 Analysis of Covariate ANCOVA, to confirmed whether to accept hypotheses one or to reject it, as shown in Table 2.

## Hypothesis One:

**Table 2: ANCOVA, Analysis of the Mean Scores for Pre & Post Test of OCAT**

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	2662.047 <sup>a</sup>	2	1331.024	9.508	.000	.096
Intercept	39363.184	1	39363.184	1.184	.000	.611
Pretest	308.831	1	308.831	2.206	.139	.012
Groups	2173.560	1	2173.560	15.526	.000	.080
Error	25058.332	179	139.991			
Total	813269.000	182				
<b>Corrected Total</b>	<b>27720.379</b>	<b>181</b>				

a. R Squared = .096 (Adjusted R Squared = .086)

Table 2 revealed that the F value analysed was 139.99 and the P-value of 0.000 was observed. Since the obtained p-value of 0.000 is lower than the alpha value of 0.05, the study rejected the null hypotheses, which says, there is no significant difference between performance scores of students taught organic chemistry using distance asynchronous instructional strategy and those taught using conventional face to face lecture. Therefore the alternate hypothesis was accepted. ( $F(2, 179) = 139.99, P = 0.000$ ).

Research Question Two: What is the mean difference between performance scores male and female students taught organic chemistry using distance asynchronous instructional strategy?

In order to answer the research questions 2; a descriptive statistics was used to find out whether there is a difference in the mean or not as shown in Table 3.

**Table 3: Means and standard deviations of students' scores of post-test OCAT for Female and Male**

Gender	Mean	Std. Deviation	N
Female	71.4048	8.37843	42
Male	67.5208	11.46129	48
Total	69.3333	10.27159	90

Table 3, shows that the mean performance score of female students is 71.44 while that of the male students is 67.52. It would appear from the difference in the mean scores that female students scored slightly higher in the OCAT than the male students. In order to ascertain whether this observed difference is real or attributed to error variance. The pre & post-test result was subjected to inferential testing of covariate ANCOVA as shown as shown in Table 4.

**Hypothesis Two:****Table 4: ANCOVA Analysis Female and Male Pre-test and Post-test of OCAT**

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	348.987 <sup>a</sup>	2	174.493	1.679	.193	.037
Intercept	22001.111	1	22001.111	211.713	.000	.709
Pretest	11.085	1	11.085	.107	.745	.001
Gender	302.717	1	302.717	2.913	.091	.032
Error	9041.013	87	103.920			
Total	442030.000	90				
<b>Corrected Total</b>	<b>9390.000</b>	<b>89</b>				

a. R Squared = .037 (Adjusted R Squared = .015)

a. R Squared = .037 (Adjusted R Squared = .015; Table 4 revealed that the F value analysed was 2.913 and the p-value of 0.091 was observed. Since the obtained p-value of 0.091 is higher than the alpha value of 0.05, the study accept the null hypothesis, and reject the alternate, the earlier difference observed was not real was attributed by error variance (F (2, 90) = , P = 0.091).

**Discussion of the Findings**

From the finding, table 2. Shows analysis of covariate ANCOVA on SPSS which revealed a significant difference, the P value is lower than, 0.05 level of significance. This result indicates there was significant difference in the performance of both group after the treatment application. As a result, it can be argued that the use of distance asynchronous learning strategy in teaching organic chemistry has been proved effective; this might have resulted from the fact that asynchronous is a new environment for teaching, and the students in this generation are digital technology enthusiasm, in which they like watching movies and playing games on electronic gadgets like smartphones and computer, engaging them on those gadgets to learn accelerated their understanding, certain studies have been found to confirm the present studies. Annabeth Aquel, Manuel Barquilla, Amelia Buan, Joy Bagaloyos (2021) in a study title 'Asynchronous Learning: Its Effects on Academic Performance and Students' Motivation in Science' the results of their study revealed that participants performed better 80% in asynchronous learning environment. Nsikak-Abasi and Udeme, Tommy (2021) in a study title Effect of Asynchronous Instructional Strategy On Learning Motivation and Scores of Postgraduate Students In Advanced Educational Research In Akwa Ibom State, Nigeria; The findings of the study revealed that students who learnt through the asynchronous instructional strategy were better motivated and scored higher in Advanced Educational Research than students who learnt through lecture method. The researcher could not lay his hands on findings that argue otherwise.

Teachers can utilized these asynchronous instructional strategy to teach students and to add, additional teaching hours to improve learners' performance especially during holidays or in situation of epidemic and pandemic,

which may lead to total or partial shutdown of schools, this claim was supported with the assertion of Dada, Alkali and Oyewola (2019) and Ogbonna, Ibezim and Obi (2019). They argue that the asynchronous instructional platform gives the learners higher cognitive achievement and greater flexibility in terms of learning duration, content and process.

However, it can also be said that there is no any significant difference in the performance in female and male, as shown in table 4; the result, clearly argue that there is no any special preference in terms of both the knowledge and operation of the digital devices, in distance asynchronous instructional strategy. Therefore gender disparity is highly overcome. This result concurs with Ogbonna, Ibezim and Obi (2019). In a study, which revealed that, there was no significant interactive effect which exists between student's gender and asynchronous learning strategy. In summary, asynchronous instructional strategy increases deeper understanding of concepts, as confirmed by literatures (Adamu & Abdullahi). The instructional strategy also enhances the use of digital technology, which is gradually flooding every sector in the world.

## Conclusion

In view of the findings of the study, the following conclusions were made.

1. There was significant difference in the mean performance of students in asynchronous organic chemistry and face to face conventional lecture, in favour of asynchronous learning.
2. There was no significant difference between male and female exposed to distance asynchronous organic chemistry.

## Recommendations

With respect to the findings of the study, the following recommendations were made.

1. It was recommended that distance asynchronous strategy should be incorporated into the science teacher training curriculum by the Ministry of Education to produce teachers who would handle asynchronous instructional strategy effectively to augment normal classes and also government, school authorities and teachers should always use distance asynchronous teaching environment to enhance, and augment, face to face teaching, in season of epidemic, pandemic, lengthy holidays, to track of their students.
2. It is recommended that while using asynchronous teaching environment, teachers and instructors should be rest assured that it is gender friendly.

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