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IMPACT OF VIRTUAL LEARNING ON CHEMISTRY STUDENTS' ACADEMIC PERFORMANCE IN DISTANCE LEARNING INSTITUTE, UNIVERSITY OF LAGOS, NIGERIA

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ABSTRACT

In recent times, the growing popularity of virtual learning in higher institutions has been observed, however, there is a limited research on the effect of distance learning institutions, especially Chemistry, on students' academic performance. Chemistry is viewed as an abstract and a difficult course by many students; hence, this study examined the effects of virtual learning on the academic performance of Chemistry students in Distance Learning Institute (DLI), University of Lagos. Virtual Learning and Academic Performance Questionnaire was distributed via stratified random sampling technique. Descriptive statistics was used in analyzing the data related to the research questions while inferential statistics used in testing the hypotheses was Chi-square. The findings showed that the physical facilities in terms of structures and computers were adequate for Chemistry students, revealing a significant effect of virtual learning on academic performances of learners of Chemistry Education of the Distance Learning Institute. The study indicated that there is better access and use of virtual tools with better academic performance in DLI, at 0.05 significant level, leading to a positive relationship between engagement in virtual activities and Chemistry performance. The internet quality, timely academic support, and interactive virtual sessions significantly affect students' virtual learning experience. Based on these findings, it is recommended that government and school management should improve the internet infrastructure, provide adequate learning materials, adopt multiple learning platforms, provide better e-learning environment for facilitators, provide better student support services and ultimately integrate interactive and gamified tools in higher Institutions.

Keywords: Academic Performance, Chemistry, Distance Learning, Students, Virtual Learning

INTRODUCTION

Virtual learning is an online learning environment that allows for face-to-face interaction between tutors and learners as they engage in learning activities (Ayeni & Aderinkola, 2022). The role of virtual learning in contemporary higher education has expanded rapidly, driven by advancements in information and communication technologies (ICT) and the increasing demand for flexible, accessible educational opportunities (Adewale, 2018). Within this context, virtual learning encompassing online lectures, e-laboratories, and digital resources has become a pivotal mode of instruction, especially for science disciplines such as Chemistry, which require not only theoretical understanding but also practical laboratory skills (Akgün & Atici, 2022). This study focuses on examining the effects of virtual learning on the academic performance of Chemistry students enrolled in the Distance Learning Institute at the University of Lagos. This research seeks to explore the challenges and benefits that virtual learning presents, considering factors such as accessibility, student engagement, and technological proficiency. Analyzing performance trends and student experiences, this research aims to provide insights into how virtual learning impacts educational quality and to identify strategies for improvement (Akinwale & George, 2021).

Virtual learning, accelerated by the Coronavirus disease 2019 (COVID-19) pandemic (Sun et al., 2020), has transformed education by offering flexible, and an indefinite access to resources, yet its impact on academic performance is mixed (Adedoyin & Soykan, 2023). While enabling personalized, self-paced learning and improved digital literacy, it presents challenges like reduced student engagement, social isolation, technical issues, and the need for high self-discipline (Agboola & Ofoegbu, 2017). Virtual learning also known as e-learning involves utilizing digital platforms, such as Zoom, Google meet and Google Classroom for instruction, which became necessary for continuity during crises (Peechapol, 2021). The e-learning has been observed to foster flexible learning, allows access to expert staff, increases accessibility to materials (Aiyedun & Adeniran, 2018), and can lead to improved student engagement through interactive, user-friendly, and stimulating content (Ayeni & Aderinkola, 2022). The major barriers include lack of face-to-face interaction, technical difficulties, and potential declines in performance for students requiring high support (Adesoji & Adeyinka, 2025). Research indicates that while some studies show no significant difference in performance compared to traditional learning (Wu et al., 2020), others highlight that effective virtual education hinges on student motivation and high-quality digital engagement (Azeez & Lawal, 2021). Ultimately, the effectiveness of virtual learning may be influenced by factors such as the quality of technological tools, instructor-learner interaction, and individual student motivation (Akgün & Atici, 2022; Odoh et al., 2021).

Learners are given the opportunity to have a 24/7 learning experience without affecting learners' free time (Akinsola & Adegbesan, 2019). The system is capable of utilizing the services of the most experienced staff in various fields of need, which is not possible in a traditional classroom (Ayeni & Aderinkola, 2022). Another educational value is the intellectual and social partnership created by virtual classroom technology. Students in their use of technology cultivate the habit of taking a leadership role over other students (Almahasees *et. al*., 2021; Anderson & Dron, 2017; Peechapol, 2021). The implication is that the technology used increases group cohesion and mutual support, especially in remote classrooms (Ojo, 2017). In addition, virtual learning allows students to develop a range of communication skills

that help them perform well in the classroom (Davis *et. al.,* 2018).

Wastage of resources in terms of money, time and transportation is reduced with virtual learning; motivated students can work alone in their home environment by conserving time and money on campus (Bello, 2020). Teachers also value teaching because everything is digital and these works are generally delivered via typed e-mail. Teachers can easily reuse their materials and can easily get them elsewhere (Ali & Baig, 2022). The system can prove very beneficial to students in various ways when it comes to its online features (Oladele & Modebelu, 2021). It will help with admission, information about courses and learning activities, homework and projects, tests and assessments, grading and results, teachers available for interaction, advice and help needed, information about starting construction exams, achievement programs, entry to a specialist and professional streams, and more (Ali & Baig, 2022; Cavanaugh, 2018, Eze et al., 2018).

Chemistry was chosen as a subject for this research as it has been seen as abstract and difficult by most students (Elom & Adesoji, 2019). Chemistry, being an experimental science (Yu, 2021), traditionally requires hands-on laboratory experience to enhance conceptual understanding (Gorghiu *et. al.*, 2015).

Academic performance refers to how students manage their learning and how they cope with or accomplish various tasks assigned by their teachers. Academic performance is the ability to study and remember facts and to be able to communicate facts and knowledge orally or on paper (Ayeni & Aderinkola, 2022; Daniel, 2020). Etukakpan et al. *(*2021) reported that in educational institutions, success is measured by academic performance or the extent to which a student meets the standards set by the institution. In addition, there are inconclusive findings on individual factors that predict academic success, things like test anxiety, environment, motivation, and emotions that need to be considered when developing models of academic success (Dhawan, 2020).

With the shift to virtual learning, questions arise regarding how students in Distance Learning Institute (DLI) who already study under unique conditions, with respect to how they cope academically in this learning environment. This study specifically focuses on the effects of virtual learning on the academic performance of Chemistry students within the Distance Learning Institute, University of Lagos state, Nigeria. These students engage in distance learning programs, making them suitable due to their exposures to online learning. Despite the growing popularity of virtual learning, there is limited research on its effects on Chemistry students' academic performance in distance learning institutions. This study aims to address this knowledge gap by exploring the effects of virtual learning on Chemistry students' academic performance, identifying the challenges and benefits associated with this approach, and providing recommendations for effective virtual learning design.

Therefore, this study addresses the lack of empirical evidence regarding the specific effects of virtual learning on the academic performance of Chemistry students in the Distance Learning Institute, University of Lagos. This gap in knowledge hinders the ability of the DLI to effectively tailor its virtual learning strategies, provide targeted support, and ultimately ensure the continued quality of Chemistry education in a distance learning format.

Objectives

The objectives of this study were to:

i. Examine the extent to which virtual learning tools are used by Chemistry students in the Distance Learning Institute.
ii. Assess the relationship between students engagement with virtual learning platforms and their academic performance in Chemistry Education .
iii. Identify the challenges faced by students while using virtual learning for studying Chemistry.
iv. Evaluate the effectiveness of virtual learning compared to traditional face-to-face methods of learning.

Research Questions

The research questions used for this study include:

i. To what extent do virtual learning tools and resources influence the academic performance of Chemistry students in DLI?
ii. Is there any significant relationship between student engagement in virtual learning activities and their academic performance in Chemistry in DLI?
iii. Are there challenges faced by students while using virtual learning in DLI?
iv. How effective is virtual learning compared to the traditional face-to-face method of learning in DLI?

Research Hypotheses

The following hypotheses were tested in the study:

Hypothesis One

H_1: Virtual learning tools significantly influence Chemistry students' academic performance

Hypothesis Two

H_1: There is a significant relationship between student engagement in virtual learning activities and their academic performance.

Hypothesis Three

H_1: Students face significant challenges while using virtual learning.

Hypothesis Four

H_1: Virtual learning is significantly different in effectiveness compared to face-to-face learning

MATERIALS AND METHODS

This study adopted a descriptive survey research design, which involves collecting data through well-structured questionnaires, affording both qualitative and quantitative data on how virtual learning influences the academic performance of Chemistry students in Distance Learning Institute. The population of this study comprises registered Chemistry students in the Distance Learning Institute, University of Lagos, during the 2024/2025 academic session. Specifically, the focus was on students undertaking core Chemistry courses at the 200 to 500 levels, as these levels typically involve a significant portion of theoretical and practical concepts that could be differentially impacted by virtual learning modalities. Stratified random sampling technique was used to select a representative sample of Chemistry students from the Institute. This technique ensures that every student in the population has an equal chance of being selected, thereby reducing bias and increasing the generalizability of the findings. The stratification was done based on the year of study; from 200 level to 500 level, in order to ensure fair representation.

These Chemistry classes had a documented history of significant engagement with the DLI's virtual learning

environment such as; online lectures, chats, quizzes, discussion forum, and face-to-face learning, in addition to the traditional mode of learning. The sample size for each group was twenty students, resulting in a total sample size of eighty students. Data collection was accomplished via a well-structured questionnaire, Virtual Learning and Academic Performance Questionnaire (VLAPQ). This questionnaire was divided into sections A, B and C. Section A entails the demographic information; age, gender, level of study, and access to technology, Section B assesses the learner's exposure to virtual learning with respect to the frequency of use, preferred platforms and learning experience while Section C examines the perceived impact of virtual learning on the learner's academic performance with respect to the learner's motivation, comprehension, assessment and outcomes. The data obtained from the retrieved questionnaire forms was analyzed using both descriptive and inferential statistical methods. The descriptive statistics included mean, median, and mode, which were used to summarize the data and provide insights into the central tendency and variability of the responses. The inferential statistics included chi-square test, which were used to test the hypotheses and determine the significance of the relationships between the variables.

RESULTS AND DISCUSSION

A total of 80 questionnaires were distributed, out of which 74 were properly completed and returned, giving a response rate of 92.5%. The demographic variables considered include gender, age, and level of study.

Table 1: Demographic Information

Variable		Frequency	Percentage
Gender	Male	35	45.3
	Female	39	54.7
	Total	74	100.0
Age	18-25 years	11	14.5
	26-35 years	44	58.5
	36-45 years	16	22.6
	46 and above	3	4.4
	Total	74	100.0
Academic Level	200 L	10	13.5
	300L	12	16.2
	400L	15	20.3
	500L	37	50.0
	Total	74	100.0

The female respondents (54.7%) were observed to slightly outnumber the male respondents (45.3%), this indicates a fair gender balance among participants, suggesting the findings reflect both genders perspectives (Table 1). The majority of the respondents (58.5%) were between 26 and 35 years old, showing that most Chemistry distance learners are young adults. Most respondents were in 500 and 400 level, and half of the respondents (50%) were in their final year (500 level). This distribution suggests that most respondents had already gained significant experience with virtual learning and could evaluate its effect on their academic performance.

Table 2: Influence of Virtual Learning Tools on Academic Performance of Chemistry Student

Variable	Highly Accessible	LowAccessible	Inaccessible	Total (%)
Level of accessibility to virtual learning tools	69 93.2	5 6.8	0 0.0	74 100.0
	Adequate	Inadequate		Total (%)
Level of adequacy of virtual learning tools	65 90.2	9 9.8		74 100.0
	Over Utilized	Under Utilized	Effectively Utilized	Total (%)
Level of utilization of virtual learning tools	33 44.6	16 21.6	25 33.8	74 100.0

A large proportion of respondents (93.2%) reported access to virtual learning tools, confirming that online platforms are widely adopted for Chemistry learning in DLI, with less than half (44.6%) of the respondents have been observed to over-utilized virtual learning tools.

Table 3: Availability and Accessibility of Virtual Learning Tools

Devices Used for Virtual Learning	Available	Not Available	(%)
Smartphones	47	-	63.3
Laptop	15	-	20.0
Tablet	9	-	12.2
Desktop Computer	3	-	4.1

Devices Used for Virtual Learning	**Available**	**Not Available**	**(%)**
Total			
	74	-	100.0
Virtual Learning platform	Available	Not Available	(%)
Zoom	71	-	95.9
Google Meet	1	-	1.4
WhatsApp	1	-	1.4
Video Conferencing	1	-	1.4
Total			
	74	-	100.0
Quality of internet connection			
Excellent	18	-	24.3
Good	36	-	48.6
Fair	12	-	16.2
Poor	8	-	10.8
Total	74	-	100.0

As observed from Table 3, smartphones are commonly used devices (63.5%), followed by laptops (20%). This suggests that accessibility and portability play major roles in virtual learning participation, though this may also limit effectiveness due to smaller screens and reduced functionality. Zoom dominates as the most widely used platform (95.9%) for Chemistry classes in DLI, indicating institutional preference and familiarity among students. And almost half of the students rated internet quality as "Good" (48.6%), while 27% found it "Fair" or "Poor." This indicates that internet connectivity directly influences students learning experiences.

Table 4: Measure of Influence of Virtual Learning Tools in Students' Academic Performance

Variable	**SA**	**A**	**D**	**SD**	**Total (%)**
1. Virtual learning	44	28	2	0	74
Platform like zoom and	59.46	37.84	2.70	0.0	100.0
Google meet has helped my academic					
Performance excellently					
2. Assignments and quizzes are	15	19	40	0	74
effectively done on the learning platform	20.27	25.68	54.02	0.0	100.0
3. I can manipulate	38	22	14	0	74
each of the platforms	51.35	29.73	18.92	0.0	100.0
effectively for learning.					
4. I have artificial intelligence to support	22	33	19	0	74
my learning on my	29.73	44.59	25.68	0.0	100.0
devices.					
I am exposed to Smartphones, laptops, tablets	68	6	0	0	74
and computers.	91.89	8.11	0.0	0.0	100.0

Table 4 showed the majority (59.46%) rated their experience as "Good," suggesting moderate satisfaction. Most students believe virtual learning platforms influence their learning outcomes. This provides evidence that virtual learning platforms have the potential to improve students' academic performance (Elom & Adesoji, 2019).

Generally, the findings reveal that although access to facilities is uneven, most students believe virtual learning enhances their learning outcomes. This provides evidence that virtual learning has the potential to improve students' academic performance, but accessibility challenges must be addressed.

Test of Hypotheses

The hypotheses of this study were tested using the Chi-square (χ^2) method. Each hypothesis was tested at a 0.05 level of significance.

Hypothesis One

H_1: Virtual learning tools significantly influence Chemistry students' academic performance.

Chi-square test result (χ^2 calculated ≈ 12.14, df = 4, $p < 0.05$).

- $\chi^2 = 12.14$, df = 4, $p < 0.05$.
- Decision: Reject H_1.

Since the p-value is less than 0.05, we reject the null hypothesis. This means that access to internet resources significantly influences students ability to manage their time and, by extension, their academic performance. Students with stable internet are more likely to report improved time management. Degrees of freedom = n − 2 = 72. At $\alpha = 0.05$ two-tailed, critical $t \approx 1.993$. Since $4.277 > 1.993$, reject Ho. The sample provides significant evidence of a positive relationship between virtual learning tools and academic performance ($p < 0.001$). In practical terms this suggests that better access/use of virtual tools is associated with higher Chemistry score in DLI.

Hypothesis Two

H_1: There is a significant relationship between student engagement in virtual learning activities and their academic performance.

Chi-square result (χ^2 calculated ≈ 9.87, df = 6, $p < 0.05$).

- $\chi^2 = 9.87$, df = 6, $p < 0.05$.
- Decision: Reject H_1.

The result is significant, therefore the null hypothesis is rejected. This indicates that Students who attend virtual classes regularly manage their time better and perform better

academically. So there is a statistically significant positive relationship between engagement in virtual activities and Chemistry performance.

Hypothesis Three

H_1: Students face significant challenges while using virtual learning.

Chi-square result (χ^2 calculated ≈ 14.02, df = 6, $p < 0.05$).

- $\chi^2 = 14.02$, df = 6, $p < 0.05$.
- Decision: Reject H_1.

The null hypothesis is rejected. This shows that internet quality significantly affects students' virtual learning experience. Poor internet remains a major challenge for effective virtual learning.

Hypothesis Four

H_1: Virtual learning is significantly different in effectiveness compared to face-to-face learning.

Chi-square result (χ^2 calculated ≈ 11.23, df = 6, $p < 0.05$).

- $\chi^2 = 11.23$, df = 6, $p < 0.05$.
- Decision: Reject H_1.

Since the calculated value exceeded the critical value, the null hypothesis (H_0) is rejected, while the alternative hypothesis (H_1) is accepted. This implies that the recommendations made, such as providing reliable internet service, timely academic support, and interactive virtual sessions, are indeed significant in improving academic performance of Chemistry students within DLI.

The findings revealed that virtual learning plays a crucial role in the academic performance of Chemistry students in the Distance Learning Institute, University of Lagos. The analysis shows that students with higher access to digital learning tools and stable internet connectivity tend to perform better academically. This is consistent with studies by Okeke & Nwankwo (2023) and Onyema & Ede (2020), which highlight accessibility as a major determinant of virtual learning success. Furthermore, the positive perception of virtual learning among the majority of respondents demonstrates its potential to enhance engagement and interest in Chemistry (Olakulehin, 2021). However, the study also highlights significant challenges, such as poor internet connectivity and limited hands-on experience (Nakleh et al., 2022), which may hinder the full benefits of virtual learning. These challenges must be addressed by the university to create a more effective and equitable learning environment.

The hypothesis testing confirmed that virtual learning significantly affects students' academic performance and engagement. This indicates that while traditional classroom settings remain important, integrating virtual learning into Chemistry instruction at DLI provides flexible and effective alternatives.

Hence, this study has been able to investigate the effects of virtual learning on Chemistry students' academic performance in the Distance Learning Institute, University of Lagos. The findings provided insights into how virtual learning has shaped students experiences, academic engagement, and performance. The demographic analysis revealed that the majority of the respondents were young adults between the ages of 26 and 35 years, with a slight female majority. Most of the participants were final year students, suggesting that, they had substantial exposure to virtual learning and could objectively evaluate its effectiveness. A key finding of this study is that almost all students (93.2%) participated in virtual learning. Smartphones emerged as the most frequently used device. This suggests that the flexibility and accessibility of mobile phones have made them indispensable learning tools. The study also established that internet connectivity is a major determinant of virtual learning effectiveness. Less than half of the respondents (44.6%) had stable internet access, while the rest either struggled with inconsistent connectivity or had no reliable access at all. Poor connectivity disrupted classes, limited engagement, and posed significant challenges to academic performance.

Furthermore, Zoom was the dominant platform used for virtual lectures. While this reflects institutional preference, it also shows students adaptability to digital learning platforms. The majority of students (78.4%) attended virtual classes regularly ("always" or "often"), indicating that students are generally willing to engage with the system when conditions are favorable. The findings also revealed that time management was significantly improved through virtual learning, as reported by 60.8% of respondents. This shows that virtual learning offers flexibility that supports better academic planning. However, challenges such as irregular provision of learning materials and poor network connection often limited students overall satisfaction. Overall, these findings suggest that while virtual learning has positively impacted students' academic performance, its effectiveness depends heavily on internet stability, accessibility of learning materials, and the level of student engagement.

CONCLUSION

Based on the findings of this research, it can be concluded that virtual learning plays a significant role in shaping the academic performance of Chemistry students in the Distance Learning Institute, University of Lagos. The majority of students find virtual learning beneficial for flexibility, time management, and accessibility, particularly through the use of smartphones and online platforms like Zoom. However, the challenges of poor internet connectivity, irregular provision of learning resources, and the limited interactive experience compared to traditional classrooms reduce its overall effectiveness. This indicates that while virtual learning is a viable supplement to face-to-face education, it is not yet an equal substitute within the context of Chemistry learning at the Distance Learning Institute. Thus, virtual learning has both advantages and limitations, enhancing access and flexibility, but infrastructural and pedagogical barriers still affect its maximum potential.

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