COMPARATIVE ANALYSIS OF UNIVERSITY STUDENTS' PERCEPTION ON PHYSICAL AND VIRTUAL LEARNING ENVIRONMENTS IN CHEMISTRY EDUCATION

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Abstract

This research investigates the perceptions of undergraduate students regarding the impact of physical and virtual learning in Chemistry education at Prince Abubakar Audu University, Anyigba, Nigeria. The study adopts a descriptive survey research design to document and describe the current status of physical and virtual learning environments without manipulation of causal factors. Data collection is facilitated through a modified four-point Likert scale structured questionnaire, validated by experts in the Department of Chemistry Education, and reliability is established through test-retest reliability techniques. Findings from the study reveal that physical learning is perceived as conducive to student engagement, interactive, and aligned with long-term educational goals, while virtual learning is viewed as facilitating high levels of student success, offering new learning possibilities, and bridging the gap between tutors and students. Both physical and virtual learning environments incorporate a blend of instructional approaches, leveraging emerging technologies to enhance teaching effectiveness. The research underscores the importance of leveraging available technology to improve the teaching-learning process and advocates for comprehensive studies on the state of Chemistry education in Nigerian schools to address funding, resource provision, and infrastructure challenges.

Key words: Students' perception, Chemistry education, Physical learning, Virtual learning, Technology-mediated instruction

Introduction

Across the world, traditional pedagogical techniques like teaching using chalkboards have long been used. Technology has changed education over time, bringing with it new and creative technologies like gamification, virtual reality (VR), artificial intelligence (AI), and learning management systems (LMS). The effects of these technological advances on instruction and learning have been the subject of growing research, which has demonstrated the overwhelmingly positive results (Agbo et al., 2021; Cheok, Shukor, & Edwards, 2021; Olugbade & Olurinola, 2021; Sunday et al., 2022; Tolorunleke, Haruna, & Olugbade, 2023; Agbo et al., 2023; Olugbade, 2023; Olugbade, & Agbo, 2024).

The emergence of the Covid-19 pandemic further underscored the necessity of virtual learning environments, leading many educational institutions worldwide to adopt and integrate these platforms into their curriculum. Despite the evident benefits of technological advancements in education, studies have identified disparities in access to such resources, particularly in Nigerian universities, where Information and Communication Technology (ICT) infrastructure remains underdeveloped compared to more affluent regions (Aduwa-Ogiegbaen & Iyamu, 2005; Ofulue, 2011; Agbo et al., 2023).

As demonstrated by a notable lack of excitement for studying in contexts without proper technical assistance, this digital divide creates obstacles to student engagement and academic achievement (Ciampa, 2014). To tackle these issues, a more thorough comprehension of how students see traditional and online learning settings is necessary, especially in the context of specialized academic fields like chemistry at Prince Abubakar Audu University in Anyigba.

The purpose of this study is to investigate how undergraduate students view traditional and online teaching approaches for chemistry. Government officials, educational administrators, curriculum developers, teachers, parents, and students will all find great value in the results. Gaining insight into the preferences and experiences of students may help develop targeted interventions that improve teaching strategies, make the most use of educational resources, and close the digital gap. Furthermore, by providing a framework for further research in this area, our study adds to the larger conversation on science education.

Statement of the Problem

The condition of ICT facilities and physical infrastructure in Nigerian universities is a growing concern for students, parents, and educators. Many of these facilities are inadequate, poorly maintained, or non-functional, exacerbated by the increasing student population. This lack of resources negatively impacts student performance and motivation, leading to apathy towards learning.

To address these issues, it's crucial to understand undergraduate students' perceptions of both physical and virtual learning environments at Prince Abubakar Audu University, Anyigba. This insight will help identify barriers to academic engagement and inform strategies to improve infrastructure and support student success.

Research Objectives

The primary aim of this research is to investigate undergraduate students' perceptions of physical and virtual learning at Prince Abubakar Audu University, Anyigba. The specific objectives are as follows:

1. To explore students' perceptions of the impact of physical learning at Prince Abubakar Audu University.
2. To assess students' perceptions of the impact of virtual learning at Prince Abubakar Audu University.
3. To examine undergraduate students' preferences between physical and virtual learning at Prince Abubakar Audu University.

Research Questions

The study is guided by the following research questions:

1. What are the perceptions of students regarding the impact of physical learning at Prince Abubakar Audu University?
2. What are the perceptions of students regarding the impact of virtual learning at Prince Abubakar Audu University?
3. What are the preferences of undergraduate students between physical and virtual learning at Prince Abubakar Audu University?

Literature Review

Conceptual Framework

Concept of Virtual Learning: The American Society for Training and Development (ASTD) defines virtual learning as a contemporary approach to education that uses electronic technology to support learning outside of traditional classroom settings. It includes a broad spectrum of instructional activities such as computer-based learning modules, virtual classrooms, web-based learning, and collaborative digital tools (Piskurich, 2013). Through a variety of electronic media, including the internet, intranet/extranet networks, audiovisual records, satellite broadcasts, interactive television, and CD-ROMs, this method allows students to access instructional materials and resources remotely. Furthermore, the E-Content Report (2014)'s definition of virtual learning emphasizes the term's ability to refer to any type of learning enhanced by electronic communication through the use of cutting-edge information and communication technologies (ICT). This broad definition includes a wide range of ICT-based processes and applications, such as online learning environments, virtual classrooms, digital collaboration tools, computer-based learning platforms, and networking possibilities (Hambrecht, 2010).

Concept of Physical Learning: Physical learning is a term used to describe a style of teaching that places an emphasis on customized and specific methods to meet the distinctive needs and strengths of every student. In contrast to conventional teaching approaches that are defined by consistent evaluation procedures and structured curriculum, physical learning values the diversity of student aptitudes and preferences. Individualized learning programs (ILPs), a term used to describe this customized approach, place a strong emphasis on the active engagement and participation of students in the learning process (John, 2010).

Physical learning, in its most basic form, acknowledges that students have unique learning styles, aptitudes, and interests, and that, in order to maximize learning results, individualized teaching techniques are required. With the help of resources and individualized support catered to their individual learning requirements, students may study in a welcoming and inclusive atmosphere thanks to our student-centered philosophy. Physical learning aims to empower students and improve their educational experiences by recognizing and respecting individual differences.

Theoretical Framework

Constructivism: A fundamental idea called constructivism holds that people actively create their knowledge and comprehension of the world by having first-hand experiences and then reflecting on them (Fosnot, 2013). Learners participate in a process of cognitive reconciliation when they

come across novel information or circumstances. This process involves integrating and comparing new experiences with their earlier experiences and current knowledge. Because of the way that new and old knowledge interact, students may decide to change their minds about what they already knew or to ignore the new information as unimportant.

The idea that students are active participants in the building of their own knowledge is fundamental to the constructivist viewpoint. Learners must have the agency to critically assess their comprehension, ask probing questions, and thoroughly investigate ideas in order to participate in this process. Adopting a constructivist approach in the classroom means creating settings that support active learning strategies, such practical experimentation and real-world problem-solving with the use of actual data wherever possible. In order to improve their comprehension and hone their grasp of difficult subjects, students are also urged to work in groups, share their views, and engage in reflection activities.

In summary, constructivism emphasizes the active role of learners in constructing their knowledge through meaningful experiences and reflection. By nurturing inquiry, exploration, and critical thinking skills, educators can empower students to become lifelong learners capable of adapting and evolving their understanding of the world around them.

Empirical Studies

Two different methods to education are represented by physical learning, which takes place in conventional classroom settings, and virtual learning, which is supported by digital resources and online platforms (Kliziene et al., 2021). While the goals of both approaches are to promote learning and information acquisition, they differ in a number of ways, such as social engagement, accessibility, interactivity, and adaptability. Physical learning necessitates that students be physically present in a specified classroom or educational institution, which presents logistical issues for individuals with limited mobility or geographic restrictions. Conversely, virtual learning provides increased accessibility since it can be accessed remotely from any place with internet connectivity, removing geographical and transit-related constraints.

In terms of interaction, in-person interactions between teachers and students provide real-time feedback, teamwork, and conversation in physical learning environments. On the other hand, while virtual learning relies on asynchronous communication channels like email and discussion boards, it could not have the same immediate human connection. To encourage involvement and engagement, virtual learning systems might include interactive elements like chat rooms, video conferencing, and multimedia presentations (Monahan et al., 2008; Martin et al., 2012).

Another important distinction between the two methods is flexibility. When studying in person, classes and lectures usually follow a set schedule that requires students to stick to certain schedules and show up for sessions at set times. Virtual learning, on the other hand, gives students more freedom by letting them access course materials and finish homework whenever it's convenient for them. Because of its adaptability, students may pursue their academic goals while juggling other personal and professional obligations. It also supports a variety of learning methods.

Lastly, there are differences in social interaction between virtual and real-world learning contexts (Li, 2013). Physical learning settings include in-person contacts, group activities, and extracurricular activities to promote social engagement and community development. However, especially in fully asynchronous online courses, virtual learning may make it difficult for students

to feel like they belong and are a team. Though more moderated and asynchronous, virtual learning platforms can nonetheless promote social engagement through online discussion boards, group projects, and virtual study sessions.

In conclusion, both in-person and online learning have benefits and drawbacks, but they complement one another in the context of contemporary education. Teachers may design inclusive, dynamic learning experiences that meet the varied needs and interests of their students by utilizing the advantages of each modality.

Methodology

Research Design

The research design employed in this study was a descriptive survey approach. Descriptive survey design, as articulated by Ali (2006), aims to document and describe the current status or existence of phenomena under investigation without manipulation of causal factors. It focuses on developing profiles of what exists rather than delving into the reasons behind their existence. This methodology was deemed appropriate for the study as it allows for the collection of respondents' views, opinions, and the assessment of available resources within the study area.

Sample Size and Sampling Technique

The study population comprises all students enrolled in Chemistry Education within the Faculty of Education at Prince Abubakar Audu University, Anyigba.

The sample for this study was drawn from the population of Chemistry Education students. The sample size consisted of one hundred (100) respondents selected through simple random sampling technique. Specifically, twenty-five (25) students were randomly chosen from each academic level (100 to 400) within the Department of Chemistry Education, resulting in a total sample size of one hundred.

Research Instrument

The instrument utilized for data collection in this study was a modified four-point Likert scale structured questionnaire, incorporating responses ranging from "Strongly Agree" (SA) to "Strongly Disagree" (SD). The questionnaire was specifically designed by the researcher to gather information relevant to the research questions. The questionnaire is divided into two sections: Section A covered demographic information, while Section B addressed the research topics identified in the research questions.

To ensure the validity of the instrument, the questionnaire was subjected to validation by three experts in the Department of Chemistry Education at Prince Abubakar Audu University, Anyigba. Their feedback and suggestions was carefully considered and incorporated into the questionnaire to enhance both its face and content validity.

Furthermore, the reliability of the instrument was assessed using a test-retest reliability technique. A pilot study was conducted in Igala-mela Odolu Local Government Area involving chemistry students not included in the target population. After a two-week interval, the same instrument was administered, resulting in a positive reliability coefficient of 0.82, indicating satisfactory reliability for the study.

Data Collection and Analysis

To ensure effective distribution of the questionnaires, the researcher employed direct administration to the sampled population. Permission was obtained from the Head of Department before distributing the questionnaires to the students. Subsequently, the questionnaires were collected immediately by the researcher after distribution.

Percentage was used in analyzing the data collected from the respondents. Factors that received a rating greater than or equal to 3 were considered acceptable, while those with a mean response below 3 were deemed unacceptable based on the respondents' feedback.

Results

We present the analysis of data collected from the field in this section. The data on social characteristics of respondents was analysed in simple percentage while the research questions were analysed using mean and standard deviation.

In this study a mean score of 2.50 and above is the acceptable range while less than 2.50 is the rejection range.

Table 1. Social Characteristics of Respondents.

Variable	Frequency	Percentage
Gender		
Male	56	56%
Female	44	44%
Total	**100**	**100%**
Age		
14-18	11	11%
19-24	32	32%
25- above	57	57%
Total	100	100

Source: Field survey, 2023

Data on Table 1 above representing social characteristics of respondents reveal that 56 percent of the respondents were males while 44 percent were females with age range of 24 and above the dominant group in the study representing more than half of the sampled population.

Research Question 1: What are the perceptions of students regarding the impact of physical learning at Prince Abubakar Audu University?

	VARIABLES	SA	A	D	SD	N	X	DECISION
1	Physical learning is student friendly	58	25	13	4	100	2.94	Accepted
2	Physical learning makes learning interactive for students	20	13	57	10	100	2.73	Accepted
3	Through physical learning, the students can easily interact with	38	40	12	10	100	2.64	Accepted

	each other to make the lesson interesting							
4	Physical learning helps to integrate long term goals of the students	17	53	20	10	100	3.35	Accepted
5	Physical learning gives credence to the student aspiration	38	52	7	3	100	4.77	Accepted

Key: SA= Strongly Agree, A= Agree, SD= Strongly Disagree, N= Respondents, x= Mean

Data on table 2 above represents the perceptions of students on the impact of physical learning in Chemistry. It was observed from the first item in the table that Physical learning is student friendly with a high mean score of 2.94 and therefore accepted. On the other hand, the items 2 which indicates that Physical learning makes learning interactive for students supports this with a high mean score of 2.73 and therefore accepted. Hence, the question on the assumption that through physical learning, the students can easily interact with each other to make the lesson interesting is accepted with the mean score 2.64. Furthermore, the question on Physical learning helps to integrate long term goals of the students is supported with 3.35 mean score and therefore accepted. Finally, it was discovered that Physical learning gives credence to the student aspiration with a mean score of 4.77

Research Question 2: What are the perceptions of students regarding the impact of virtual learning at Prince Abubakar Audu University?

	VARIABLES	**SA**	**A**	**D**	**SD**	**N**	**X**	**DECISION**
1	Virtual learning helps student attain high level of success	14	65	11	10	100	2.55	Accepted
2	Virtual learning offers a variety of new possibilities to the students	14	49	27	10	100	2.56	Accepted
3	Virtual learning helps in reducing the distance between tutor and students	28	47	10	5	100	2.55	Accepted
4	Through virtual learning, students can know and understand the internet and its usage	36	54	5	5	100	3.28	Accepted
5	Virtual learning helps in the technological development of the students	37	50	10	3	100	3.24	Accepted

Key: SA= Strongly Agree, A= Agree, SD= Strongly Disagree, N= Respondents, x= Mean

Data in table 3 above reveals the perceptions of students on the impact of virtual learning in Chemistry. The respondents' data on the assumption that Virtual learning helps student attain high level of success reveal an acceptable mean score of 2.55. However, the question that Virtual learning offers a variety of new possibilities to the students gained a mean score of 2.56 and therefore accepted. In the same vein, respondents' data on the assumption that Virtual learning helps in reducing the distance between tutor and students also got a high mean score 2.55 and

therefore accepted. Furthermore, the question which borders on through virtual learning, students can know and understand the internet and its usage has an accepted mean of 3.28. Finally, the question on Virtual learning helps in the technological development of the students has an acceptable mean of 3.24.

Research Question 3: What are the preferences of undergraduate students between physical and virtual learning at Prince Abubakar Audu University?

	VARIABLES	SA	A	D	SD	N	X	DECISION
1	Electronic education is not the most effective choice in all situations	34	39	17	10	100	3.24	Accepted
2	Students may feel isolated through the virtual learning	29	19	50	11	100	2.4	Accepted
3	Students with language difficulties may experience a disadvantage in a text-heavy online environment	20	10	57	3	100	2.22	Accepted
4	Subjects requiring physical demonstrations of skill such as laboratory work, physical education, or foreign language may not be practical in a technology-mediated setting	36	54	5	5	100	3.28	Accepted
5	Virtual learning makes students have difficulty in area of social development	36	54	5	5	100	3.28	Accepted

Key: SA= Strongly Agree, A= Agree, SD= Strongly Disagree, N= Respondents, x= Mean

Data on table 4 above represents Opinion on the preference of physical learning and virtual learning by the undergraduate students in Chemistry. Respondents' data on electronic education is not the most effective choice in all situations gained high mean score of 3.24 and therefore accepted. Similarly, respondents' data reveals that Students may feel isolated through the virtual learning got a low mean score of 2.4 and so rejected. Furthermore, respondents' data also show that Students with language difficulties may experience a disadvantage in a text-heavy online environment with a mean score of 2.22 and therefore accepted. Also, data on the assumption that Subjects requiring physical demonstrations of skill such as laboratory work, physical education, or foreign language may not be practical in a technology-mediated setting got a high mean score of 3.28 and was accepted

Discussion and Findings

It was discovered that physical learning encourages student involvement, which was in line with the first study question, which examined how students perceived the value of physical learning in Chemistry. It also promotes interactive learning settings, which increase student engagement by allowing them to actively participate and work together with their classmates. Additionally, hands-on instruction helps students match their academic objectives with their long-term ambitions. This supports the findings of John (2010), who found that physical learning plans may be used to manage lifelong learning activities either on an individual basis or in communities of interest.

Regarding the second research question, which explored students' perceptions of the impact of virtual learning in Chemistry, it was revealed that virtual learning facilitates high levels of student achievement. Furthermore, it introduces students to a multitude of new learning opportunities and enables them to develop technological skills. Virtual learning also bridges the gap between tutors and students, offering greater accessibility and flexibility in educational delivery. These findings are consistent with Rosenbarg et al.'s (2013) study, which emphasizes the necessity of integrating virtual learning programs into educational systems. This integration requires comprehensive changes to curriculum, infrastructure, teacher training, and assessment methods.

Educators employ a wide range of teaching strategies in both physical and virtual learning contexts. These methodologies range from classic "chalk and talk" approaches to constructivist models emphasize collaborative learning. Teachers often combine components from both pedagogical orientations in technology-enhanced classrooms, taking use of new possibilities and tools to maximize the efficacy of their instruction. Conventional teaching approaches, which are marked by direct instruction and passive student participation, frequently entail the instructor acting as the main information source, giving lectures and imparting knowledge to the class. This method, sometimes known as "chalk and talk," places a strong emphasis on the teacher-student transfer of knowledge with little room for student participation or critical thinking.

Constructivist learning methods, in contrast, place a strong emphasis on the value of student-centered strategies that encourage engagement, inquiry-based learning, and group problem-solving (Fosnot, 2013). Through practical experiences, group discussions, and real-world applications, students are encouraged to create their own understanding of topics in various situations. Teachers take on the role of learning facilitators, assisting students with their research and offering assistance when required. Teachers in tech-enhanced classrooms combine aspects of constructivist and traditional methods to create dynamic and interesting learning environments. They make use of cutting-edge tools and digital technology to improve student-centered learning and the efficacy of their instruction. For instance, interesting material may be delivered through interactive whiteboards, multimedia presentations, and internet resources. Collaborative platforms and virtual learning environments, on the other hand, enable dynamic conversations and group projects.

This educational approach acknowledges that teachers are no longer only information providers, but are instead facilitators of knowledge development. It highlights how crucial it is to design learning environments that accommodate a variety of learning preferences and promote active engagement, critical thinking, and the development of problem-solving abilities. Through the use of components of both constructivist and conventional techniques, educators may design meaningful and engaging learning experiences that provide students with the necessary skills to thrive in an increasingly digital and connected world.

Conclusion

The significance of Chemistry knowledge cannot be overstated, as it serves as a cornerstone for societal advancement. Safeguarding the future of Chemistry in Nigeria is paramount for the nation's scientific progression and industrial development to meet global standards. The rapid pace of technological and social change necessitates a commitment to lifelong learning. Traditional classroom settings often fall short in meeting the evolving learning needs driven by such changes. Consequently, virtual learning emerges as an increasingly favored alternative to conventional classroom methods.

The transition towards online teaching and learning gains momentum alongside advancements in computing technology and pedagogical research on the internet. Web-based learning has become integral to the educational landscape, offering unprecedented accessibility and flexibility for both students and educators. However, many existing instructional websites primarily disseminate course materials without providing adequate support for active knowledge construction.

As a result, learners often passively consume presented materials without engaging in meaningful learning experiences. To fully harness the potential of virtual learning, it is imperative to design platforms that facilitate active participation, critical thinking, and knowledge construction. Effective instructional design should prioritize learner engagement, interactivity, and collaborative learning experiences to optimize the educational impact of web-based platforms.

Recommendations

It is recommended that educators make use of the technology at their disposal to improve the quality of instruction and learning for students, parents, teachers, administrators, and curriculum creators. By delivering educational resources like a ship to faraway locations, virtual classrooms provide access to materials that would not otherwise be available. They successfully remove geographical obstacles, enabling access to education wherever one is and promoting a learning environment that is omnipresent. Furthermore, distance learning is made easier by virtual classrooms, allowing students to participate in instruction from a distance.

It is recommended that thorough investigations on the quality of chemistry instruction in Nigerian schools be commissioned by the federal and state governments. This is essential to recognize the pressing need for increased funding, provision of quality materials and equipment, and the improvement of physical facilities. Creating a supportive environment is crucial to inspire interest and enthusiasm for learning Chemistry among students.

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