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HIGHER EDUCATION IN NIGERIA: A CASE STUDY OF IMPROVIZATIONAL APPROACHES TO BLENDED LEARNING AT THE FEDERAL UNIVERSITY OF EDUCATION, KANO

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Abstract: Blended learning is an emerging concept that employs active processes in both real and virtual environments and passive mechanisms to enhance teaching and learning experiences. However, its adoption in Nigerian public institutions is hampered, in part, by a shortage of ICT facilities and insufficient skilled teachers. The current study sought to devise a strategic improvisation using handheld cellular devices available to students to experiment with the blended learning methodology, thereby verifying its feasibility and assessing its potential impact on students' academic performance. A true experimental design was used with a treatment group of 20 randomly chosen students from 82 students. The treatment group was subjected to a blended learning approach using the Google Classroom platform, whereas the control group was limited to traditional teaching methods. The performance of the various groups was measured using a teacher-made achievement test, and the collected data were analyzed using SPSS software. A one-tailed, one-sample t-test was employed to determine whether the treatment group's mean achievement score (M=31.5) improved significantly. The result of the average mean achievement score of students taught using blended learning pedagogy (M=48.35, SD=13.236) was substantially higher than the typical average mean achievement score of students, t (19) =3.075, p=0.002, d=1.273,95% Cl [0.762,1.760]. It is thus suggested, among other things, that university administrations offer sufficient ICT infrastructure to facilitate the seamless adoption of blended learning.

Keywords: Blended learning, technology in education, teacher-made achievement test, academic performance, and virtual classroom.

INTRODUCTION

The contemporary education landscape is undergoing a transformative shift, propelled by technological advancements, space and resource constraints, and overall system efficiency improvements (Kintu et al., 2017). Although traditional face-to-face teaching is effective, it faces challenges with overpopulation and resource inadequacies, which are particularly evident in Nigerian higher education institutions (Federal Ministry of Education, 2013). In contrast, e-learning provides flexible, internet-based education, enabling learners to engage anytime and anywhere, albeit with drawbacks such as potential isolation and limitations in acquiring hard skills (Nazarenko, 2015). Bridging these approaches, blended learning combines the strengths of classroom interaction and technologically enhanced online learning, thus fostering an active and interactive learning environment

(Lalima & Lata-Dangwal, 2017). Initially used in industrial settings, blended learning has extended to academic spheres, promoting diverse interactions and integrating assessment mechanisms through information and communication technology (ICT) gadgets (Andrew, 2011). In Nigeria, where the education system relies heavily on face-to-face instruction, the challenges of overpopulation and insufficient resources persist, necessitating strategic improvisations like implementing blended learning using handheld cellular devices to enhance academic performance (Jaja, 2013). This study explores the feasibility and impact of an improved blended learning strategy on student outcomes.

LITERATURE REVIEW

Conceptual Meaning of Blended Learning

Blended Learning (BL), which is widely adopted in higher institutions, has been defined diversely, reflecting its dynamic growth without clear benchmarks for innovative practices (Dziuban et al., 2018). The United States Department of Education characterizes BL as a system that merges online and in-class instruction within flexible seating times (Parsad & Lewis, 2008). Lalima and Lata-Dangwal (2017) considered BL to be a comprehensive approach that integrates direct, indirect, and collaborative teaching with personalized computer-assisted learning. According to Namyssova et al. (2019), BL leverages both active tools (Skype, group chats, web conferences) and passive tools (blogs, social networks, email) for teaching and learning. Aligning with these definitions, this study affirms BL as an innovative strategy that harnesses active and passive processes in physical and virtual realms to enhance overall teaching and learning experiences.

Implementation Models of Blended Learning

Pedagogical blueprints crucial for the successful implementation of BL are encapsulated in four distinct models: the rotation model, the flex model, the la carte model, and the enriched virtual model (Smith, 2020). As the foundational framework, these models collectively underpin the execution of BL systems, offering various practical approaches. The subsequent sections intricately delineate the specifics of each pedagogical approach within the realm of BL.

- **Rotational model:** Rotational models are widely implemented at the primary school level in California (Smith, 2020). Teachers choose whether to conduct lessons in the physical classroom or online, with the aim of guiding students through different stations according to predetermined schedules. The four rotational forms include station rotation, lab rotation (in a computer lab), individual rotation (freely moving between physical and online platforms), and flipped classroom rotation (main content online, with supportive activities in the physical classroom). Each model caters to different instructional needs and preferences (Smith, 2020).
- **Flex Model:** In the Flex model, the predominant mode of learning unfolds through an online platform, complemented by face-to-face sessions in a physical classroom (Smith, 2020). This approach offers the advantage of accommodating diverse learners in addition to a range of academic, behavioral, and socioeconomic challenges. Students can access learning materials independently, allowing for self-paced learning and practice in the digital realm. The application of the Flex model in blended learning can vary, with some opting for daily or weekly face-to-face sessions to emphasize the flexibility of the approach. Regardless of the chosen frequency, the Flex model prioritizes online platforms over traditional face-to-face interactions (Smith, 2020).
- **A La Carte Model:** In this La Carte model, a student enrolled in a full-time physical class program opts to enhance their learning experience by incorporating an additional online course for personal enrichment (Eilers, 2020). This model functions as a supplementary system, drawing from various streams such as Courser, LinkedIn

Learning, edX, Khan Academy, Canvas, Audacity, YouTube Learn@Home, TedEx, and Udemy, all of which fall under the category of Massive Open Online Courses (MOOCs) and are freely accessible (Eilers, 2020).

- **Enriched Virtual Model:** The Enriched Virtual model tailors the medium of instruction based on the student's location. A student can start a course in a physical classroom but transition to online learning in response to emerging situations. Within the same program, some students opt for distance learning online, whereas others attend traditional physical classroom settings. In essence, the Enriched Virtual model allows for a blended approach, seamlessly integrating both online and classroom experiences (Smith, 2020).

Empirical Studies

This literature review delves into empirical studies exploring the implementation of BL pedagogy and its effectiveness, with a focus on students' performance outcome as a dependent variable and various independent variables such as student characteristics, background, and design features. Notably, in Malaysia, secondary schools leverage BL practices to enhance English language proficiency by employing tools like classroom technology, internet-based virtual communication, social networking software, e-learning, and mobile learning (Siew-Eng & Muuk, 2015). Strategic solutions for higher education, as highlighted by Pavla et al. (2015), emphasize the importance of well-trained and supportive teachers utilizing diverse teaching instructional materials for cost-effective, high-quality education. However, successful BL implementation requires meticulous preparation, including financial investments, rigorous efforts, and positive attitudes from stakeholders, teachers, and students (Lalima & Lata-Dangwal, 2017).

A study conducted at a Ugandan university, as reported by Kintu et al. (2017), analyzed BL efficacy, considering students' characteristics, background, and design features as independent variables and students' performance as the dependent variable. Results indicated that these factors significantly predicted students' learning outcome in blended learning. Further investigations into BL effectiveness were conducted by Kenney and Newcombe (2011) and Garrison and Kanuka (2004), who focused on factors such as grades, retention, course completion, and graduation rates. Kenney and Newcombe found that participants in BL pedagogy often achieved higher average scores than their non-BL counterparts, while Garrison and Kanuka reported increased course completion rates and heightened student satisfaction. However, Kazu and Demirkol (2014) revealed no significant differences in academic achievement, grade dispersion, and gender performance between students in BL pedagogies.

Benefits of Blended Learning

BL is an invaluable asset that amalgamates the advantages of physical and online educational systems. The profound impact of the COVID-19 pandemic prompted a paradigm shift toward online platforms for individuals, institutions, and organizations, revealing previously untapped potentials – a transformative development in contemporary education (Namyssova et al., 2019). In the post-pandemic landscape, the seamless integration of physical and online activities has established blended learning as the new normal. The educational realm has irreversibly evolved, marking an enduring change that is here to stay. Given this context, this study aimed to introduce BL implementation using handheld cellular devices and evaluate its feasibility and potential impact on students' academic performance.

METHODOLOGY

Research Design

The study adopts a true experimental design, offering a structured approach for manipulating and controlling the independent variable (BL) and assessing the dependent variable (students' performance scores) while minimizing the impact of extraneous variables. The experimental design incorporates the flex model using Google Classroom, a free blended learning platform developed by Google, as shown in figure 1. The class code serves as the access password for members of the experimental group who were randomly selected for participation. This method ensures a systematic and controlled implementation of blended learning.

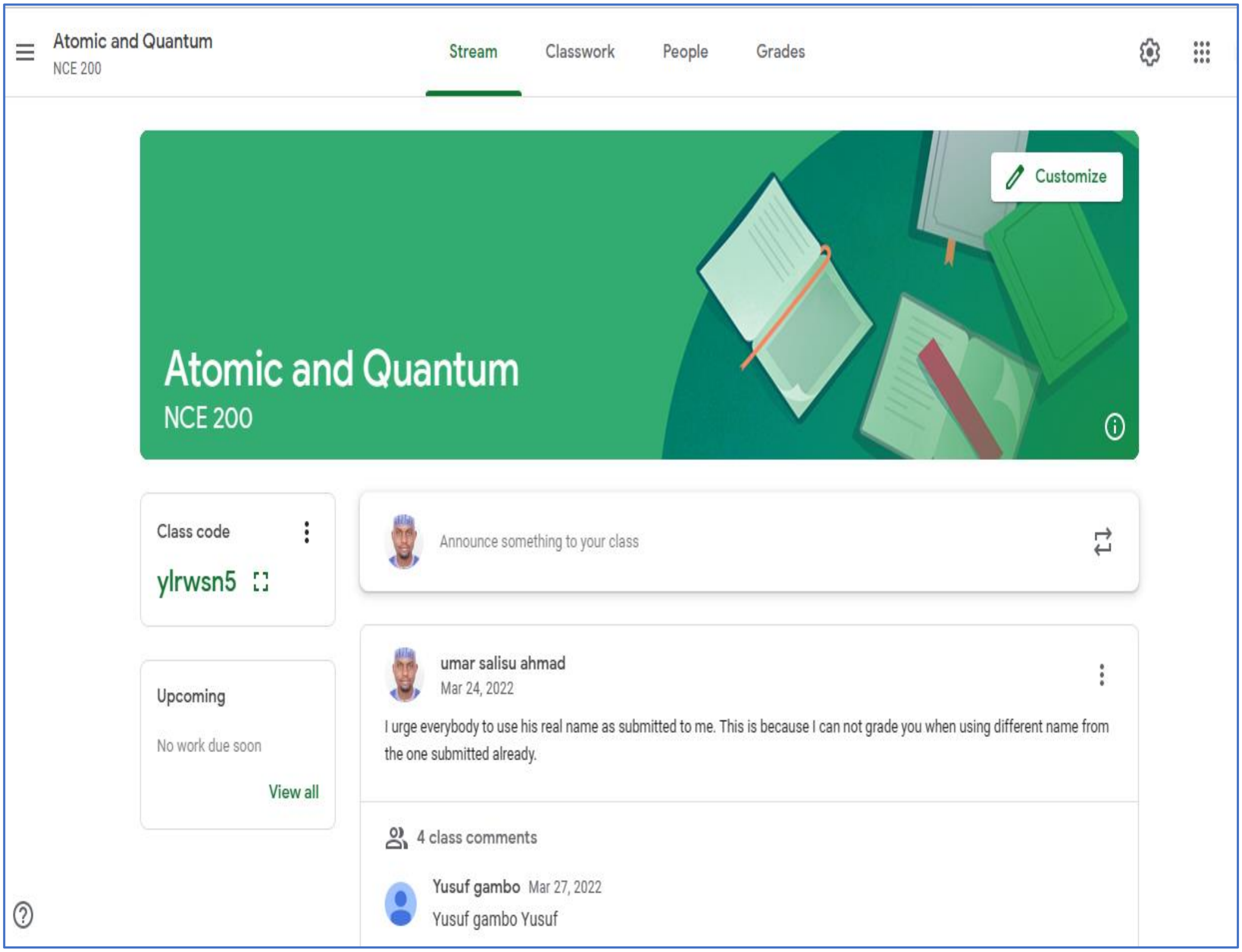

Figure 1: Virtual classroom showing stream of announcements and the class invitation code (google classroom)

Research population sampling and sampling techniques

The research targeted Nigerian Certificate in Education (NCE) 200-level students enrolled in physics-related combinations, specifically those taking the Atomic and Quantum Physics course during the 2021/2022 academic session at the Federal University (formerly College) of Education, Kano, Nigeria. The study involved 82 students from three distinct combinations: computer/physics, mathematics/physics, and integrated science/physics. Probability sampling techniques were employed for population sampling using a simple random sampling method. This involved a paper toss containing YES or NO for the entire population, ensuring fairness through replacement to allow independent selection. The experimental group comprised 20 students, figure 2 shows (i.e. 32% of the NCE 200 cohort), while the control group comprised the remaining 62 students.

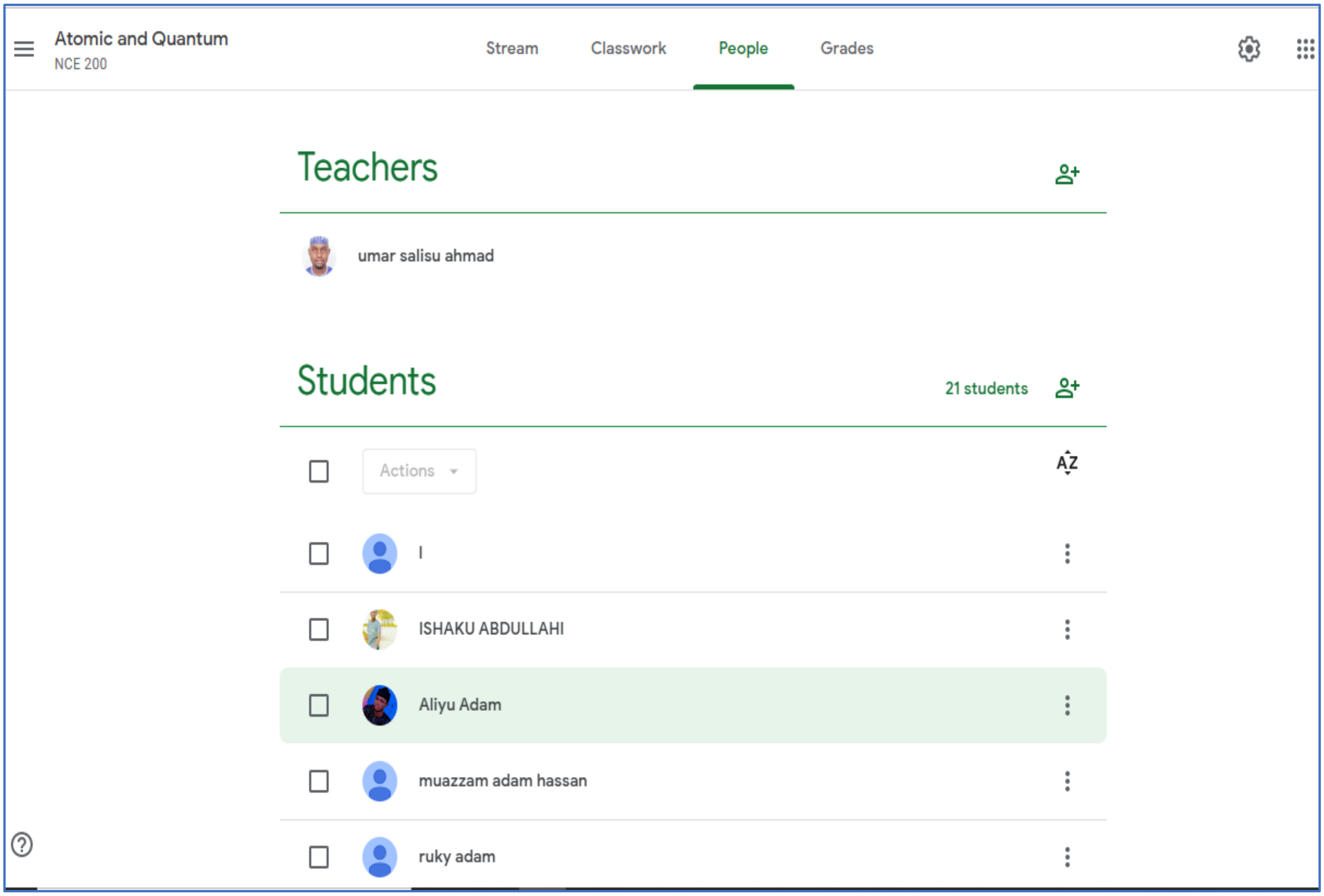

Figure 2: Members' list of the experimental group

Instrumentation and Data Collection

In undertaking this research, a robust quantitative methodology utilizes psychometric test procedures to thoroughly assess the cognitive abilities of the entire specific population. The aim of this research is to delve deeply into the academic landscape, specifically focusing on the challenging domain of Atomic and Quantum Physics.

The backbone of this investigation was the carefully crafted data collection instrument, comprising both a test and an end-of-semester examination. This instrument, designed to measure the cognitive prowess of participants, adopts an essay format to extract nuance in the academic performance. The test comprises three probing questions, while the end-of-semester examination elevates the complexity with four comprehensive questions.

Research Hypotheses

H_0: There is no significant improvement in the academic performance of students using blended learning.

H_a: There is significant improvement in the academic performance of students using blended learning.

Hypothesis Testing

To substantiate our findings, the hypotheses were subjected to rigorous testing at the 0.05 significance level using a one-sample t-test. The analytical journey involved the application of a positive one-tailed t-test to compare the means of the two groups. The outcome of this statistical analysis guides the acceptance or rejection of the null hypothesis, providing crucial insights into the cognitive landscape of the participants.

RESULTS

Normalization of Dataset

The one-sample t-test method was used to analyze the obtained data, contingent upon the prerequisite of a roughly normal distribution. To validate this assumption, histograms were employed for graphical representation, showcased in figures 3 and 4. To rectify the skewed distributions, bootstrapping was applied using resampling techniques to generate a sampling distribution of means. This normalization process aimed to approximate a normal distribution despite the initial skewed dataset distributions.

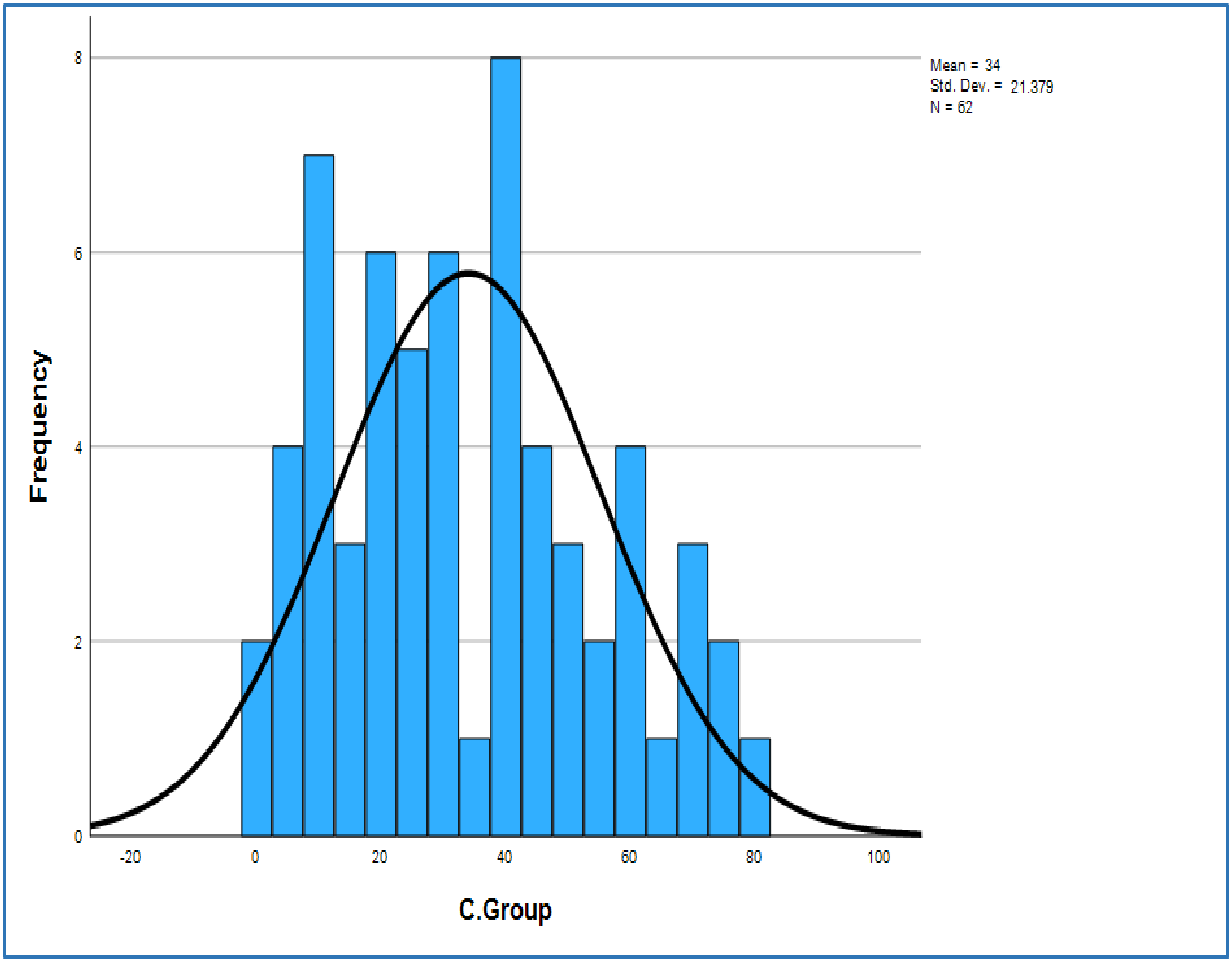

Figure 3: Histogram showing the skewed distribution of the control group dataset and the normal distribution curve before bootstrapping.

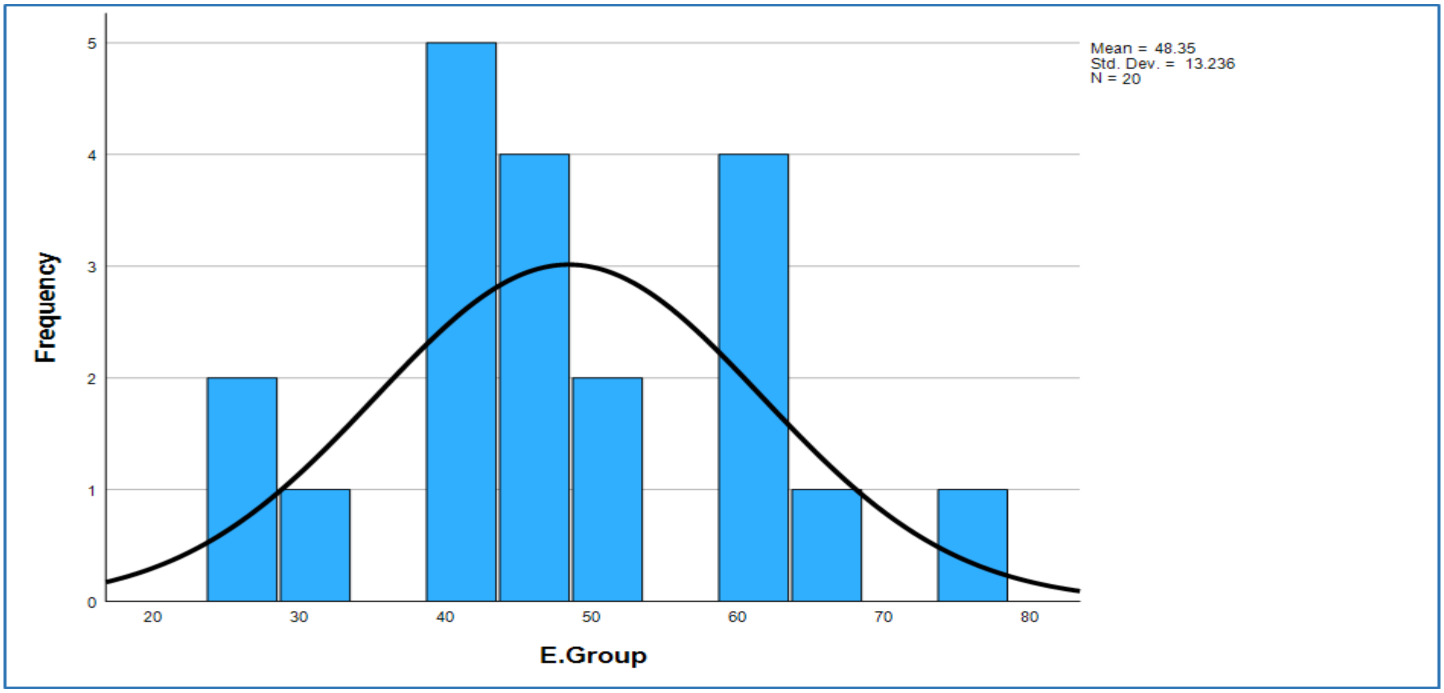

Figure 4: Histogram showing the skewed distribution of the experimental group dataset and the normal distribution curve before bootstrapping.

Both datasets passed through analysis using SPSS software, including bootstrapping and one-sample t-test procedures. Table 1 summarizes the critical statistics for the normalized datasets of both the control and experimental groups. Post-bootstrapping, the mean and standard deviation for the control group were 31.50 and 20.378, respectively. While the experimental group retained an initial mean of 48.35 and a standard deviation of 13.236. By scrutinizing the parameters at a 5% confidence interval, both groups demonstrated normal distributions having equal number in each group, making them suitable for subsequent one-sample t-test analyses.

Table 1: Statistical parameters of the experimental and control groups after bootstrapping.

One-Sample Statistics						
Groups		Statistic	Bootstrap[a]			
			Bias	Std. Error	Confidence interval of 90%	
					Lower	Upper
Expr.	N	20				
	Mean	48.35	0.00	0.00	48.35	48.35
	Std. Deviation	13.236	0.000	0.000	13.236	13.236
	Std. Error Mean	2.960				
Control	N	20				
	Mean	31.50	0.00	0.00	31.50	31.50
	Std. Deviation	20.738	0.000	0.000	20.738	20.738
	Std. Error Mean	4.637				
[a] Unless otherwise noted, bootstrap results are based on 62 stratified bootstrap samples.						

Analysis

Table 2 outlines the outcomes of the one-sample t-test, revealing a mean difference of 16.850 between the experimental and control groups. The 90% confidence interval for the experimental group ranged from 11.73 to 21.97 on the positive side, whereas the control group's interval spanned zero. This implies a unilateral positive effect favoring the experimental group. In addition, the t-value for the experimental group, computed at 3.075 with an alpha level of 0.05 and 19 degrees of freedom, exceeds the critical value of 1.729 for a one-tailed test. The resulting p-value of 0.002 is statistically significant, indicating a notable difference in mean achievement scores between the two groups.

Table 2: One-sample t-test parameters tested compared to mean of 31.5 and alpha level of 0.05 showing the t-value, mean differences, and confidence interval of the difference.

One-Sample Test								
	t-value	c-value	df	Significance		Mean Diff.	90% Confidence Interval of the Difference	
				One-Sided p	Two-Sided p		Lower	Upper
Expr.	3.075	1.729	19	0.002	0.004	16.850	11.73	21.97
Control	0.000	1.729	19	0.500	1.000	0.000	-8.02	8.02

Using the 90% confidence interval for the one-tailed test, both Cohen's d-point estimate (1.273) and Hedges' correction (1.222) in Table 3 are positive and do not intersect zero for the experimental group. These consistent findings affirmed that the experimental group, exposed to blended learning pedagogy (M = 48.35, SD = 13.236), experienced significant improvements in mean achievement scores, leading to the rejection of the null hypothesis. Thus, it can be inferred that blended learning positively impacts students' mean achievement scores compared to traditional methods in the control group.

Table 3: One sample effect size showing Cohen's d and Hedges' correction values.

One-Sample Effect Sizes					
		Standardizer[a]	Point Estimate	Confidence interval of 90%	
				Lower	Upper
Expr.	Cohen's d	13.236	1.273	0.762	1.760
	Hedges' correction	13.789	1.222	0.731	1.689
Control	Cohen's d	20.738	0.000	-0.368	0.368
	Hedges' correction	21.604	0.000	-0.353	0.353
[a.] The denominator used to estimate effect sizes. Cohen's d was calculated using the sample standard deviation. Hedges' correction uses the sample standard deviation plus a correction factor.					

Discussion

To assess the impact of blended learning pedagogy on physics students, a one-tailed, one-sample t-test was employed to determine if there is a significant improvement in mean achievement scores (M = 31.5). The results indicated a statistically significant increase in the average mean achievement score for the students exposed to blended learning (M = 48.35, SD = 13.236) compared with the typical average (t (19) = 3.075, p = 0.002, d = 1.273, 95% CI [0.762, 1.760]). This highlights the effectiveness of blended learning in enhancing students' mean achievement scores.

The observed improvement can be attributed to the dual benefits of real class contact and virtual interaction experienced by the experimental group. The use of short video clips in blended learning was particularly beneficial for understanding highly abstract concepts, thus surpassing the limitations of traditional verbal explanations. This finding is in line with previous studies, such as Siew-Eng and Muuk's (2015) report on Secondary Schools in Malaysia improving English proficiency through blended learning.

Comparisons with traditional face-to-face systems, as noted by Kenny and Newcombe (2011), further support the superiority of blended learning, as participants often achieved higher average scores. Garrison and Kanuka (2004) reinforced this notion by demonstrating that blended learning significantly increased course completion rates and student satisfaction.

Additionally, the study's positive outcome may be attributed to the accessibility of course content via mobile phones, fostering increased reading habits among students. This multifaceted approach of blended learning, combining real and virtual elements, evidently contributes to a more enriched learning experience, thus reinforcing its efficacy in the context of physics education. (Reference: Kenney & Newcombe, 2011; Garrison & Kanuka, 2004; Siew-Eng & Muuk, 2015)

CONCLUSION

As the educational landscape undergoes continuous transformation, this study highlights the transformative power of blended learning in physics education. Beyond technological augmentation, blended learning emerges as a dynamic pedagogical approach seamlessly integrating traditional and virtual elements. This integration is instrumental not only in boosting students' engagement but also in fostering deeper understanding and academic success.

This research contributes to an expanding body of evidence supporting the adoption of blended learning, encouraging its exploration and implementation across diverse educational contexts. Blended learning is more than a technological adaptation; it is a strategic educational tool that fosters enhanced reading habits and facilitates the profound comprehension of challenging subject matter. The findings advocate the deliberate integration of blended learning into abstract courses, promoting an enriched educational experience and improved academic outcomes.

Recommendations

1. Curriculum planners should emphasize the use of blended learning pedagogy in teaching methods.
2. Governments and NGOs should encourage the implementation of blended learning pedagogy through the provision of special interventions such as the provision of ICT gadgets.
3. Seminars and workshops should be held in citadel of learning to train educators on the implementation of blended learning.

Authorship contribution statement

Ahmad Umar Salisu: Conceptualization, Data curation, Formal analysis, Methodology, Project administration, and writing (original draft). **Yaro Ibrahim Getso:** Conceptualization, Data curation, Investigation, Methodology, Supervision, Validation, Writing–review and editing. **Umar Abubakar Idris:** Conceptualization, Data curation, investigation, resource supervision, validation, and writing (original draft).

Declaration of competing interests

The authors declare that they have no competing financial interests that appear to have influenced the work reported in this paper.

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