Effect of Video-Based Micro-Learning Strategy on Secondary School Chemistry Students' Performance in Acid-Base Titration in Imo State

By

Leonard Chimuanya Nwafor (PhD)
Directorate of General Studies, Kingsley Ozumba (KO) Mbadiwe University
Ideato, Imo State, Nigeria
nwaforchileo@gmail.com

Jacqueline Tamunomininim Eri-victor (PhD)
Department of Curriculum Studies and Educational Technology
Faculty of Education
University of Port Harcourt, Rivers State

&

Onini Edith Smart
Department of Science Education
Faculty of Education
University of Port Harcourt, Rivers State, Nigeria.

Abstract

The study investigated the effect of a video-based micro-learning strategy on secondary school Chemistry students' performance in Acid-Base Titration in Nwangele Local Government Area, Imo State. The influence of gender on Chemistry students' performance was considered. Two objectives, two research questions cum hypotheses were tested. Quasi-experimental design was employed in the study. One hundred and five (105) Chemistry students from two co-educational secondary schools purposively selected participated in the study. The instrument titled: Acid-Base Titration Performance Test (ABTPT) was developed, validated, and used to gather data. Mean and Standard deviation helped in answering the research questions. An ANCOVA was used to test the hypotheses at the 0.05 level of significance. The findings of the study revealed that a significant difference existed between the academic performance of students in experimental and control groups. In addition, gender had no influence on Chemistry students' performance in the video-based micro-learning group. It was recommended that Chemistry Teachers at the secondary school level should expose Chemistry students to a video-based micro-learning strategy in the 21st century to encourage this significant emerging trend in educational technology. This will increase students' engagement in the classroom towards improving academic performance in Chemistry practical.

Keywords: Video-based, Micro-learning, Acid-Base, Titration

Introduction

Secondary school education significantly boosts personal development, inculcates problem-solving and critical thinking skills in students for societal relevance. This is true because education generally provides an avenue for training and learning in schools, which develops human intellect, technical skills, character, and effective citizenship for self-reliance and national development. The ultimate purpose of education, according to Nwafor and Osuala (2024), is to empower an individual to excel in a chosen field of endeavor or career and to be able to positively impact his/her environment. This can be achieved through the number of subjects students are exposed to while pursuing their secondary school education.

Nigeria today needs more people with knowledge of science and technology. This is so because the wealth, influence, and power of any nation depend on its capacity and capability to utilize science and technology for socio-economic development. It is therefore interesting to say that science and technology are the pivot upon which national development revolves. The growth in the field of science and technology encourages a better economy in every nation, especially a developing country like Nigeria. As science and technology grow increasingly, the teaching of science subjects, especially Chemistry at the secondary school level of education, continues to call for 21st-century innovative, interactive, and student-centred instructional strategies for easy implementation of science education curriculum. Besides, for Nigeria to realize accelerated development in the 21st century, it needs qualitative science education. Science education is the gateway to opportunities, the foundation of a knowledge-based and innovation-driven economy. This is true because scientific literacy helps individuals to understand their environment, interpret natural phenomena, participate in social responsibilities, and take decisions on issues concerning scientific development. Supporting this, Idris (2021) stated that every nation must take science education very seriously in all institutions of learning. Many of the developed parts of the world were able to achieve so much in science and technology because of science education. The launching of Sputnik by the Russian Government on October 4, 1957, would not have been possible if not for quality science and technology education. Without science education, Information and Communication Technology (ICT) would be almost impossible. Nevertheless, Chemistry as an integral part of science education plays a very vital role in scientific and technological development. This is evidenced by the impact of Chemistry on Engineering,

Medicine, Agriculture, Pharmacy, and other scientific disciplines. Science education is very much required for the elevation of a nation from a consumer position to a producing position, and also changes a nation from its developing stage to a developed nation. Acquisition of appropriate scientific and technological skills is necessary to cope with the challenges presented by the evolving needs of modern work, placed in Nigerian industries, and the ever-growing non-formal sectors. Education and training institutions that respond adequately to these demands will therefore contribute to the effort to overcome the growing unemployment and marginalization of the majority of the populace.

Chemistry education is, therefore, very important to any growing economy. Many graduates of Chemistry are self-employed and employers of labour. Many own schools where people work and earn their living. In most secondary schools that embrace entrepreneurial education, students of Chemistry acquire entrepreneurial skills that enable them to be self-reliant after leaving secondary school. Chemistry is one of the core science subjects that lay the foundation for further study of science education and other chemistry-related disciplines. Chemistry education produces the needed technologists and future scientists, as well as skilled, scientifically literate citizens who are required to positively turn the nation's economy around. The desired technological advancement is possible only when the teaching of Chemistry in secondary schools is effective. However, Chemistry students' performance in external examinations needs enhancement.

The poor academic performance of students in Chemistry could thus be attributed to the teaching strategies employed by teachers during instruction. Learning in the 21st century has become student-centered. The way students learn and the way they process information are also changing. This therefore calls for the need to search for and adopt strategies that could scaffold learning, enhance creativity, promote meaningful learning, improve academic performance and retention, and encourage knowledge application in real-life situations. To teach effectively, teachers need to possess adequate pedagogical content knowledge, understand new learning theories, as well as knowledge of the students and their characteristics. Chemistry teaching is meant to be result-oriented and student-centered. This can only be achieved when students are willing and the teachers are favorably disposed to using the appropriate strategies and resources in teaching the students. Several educators like Isidor (2019), Kalu (2020), and Nkemka (2021) have employed different strategies such as demonstration, discussion, and field trip in teaching Chemistry

concepts. The Federal Republic of Nigeria (FRN, 2014) in its Chemistry curriculum document stipulated that Chemistry should be taught in such a way that will help the students acquire adequate laboratory skills, meaningful and relevant knowledge in Chemistry through field studies, guided inquiry, and laboratory techniques. In line with the above, Chemistry teachers are expected to ensure effective and meaningful teaching of Chemistry concepts to the students. Nevertheless, the inappropriate instructional strategies adopted by most Chemistry teachers during classroom instruction have led to the poor academic performance of students in Chemistry external examinations. The West African Examinations Council (WAEC) Chief Examiners' Reports in 2018, 2019, 2020, 2021, 2022, and 2023 emphasized that students' academic performance in Chemistry was very poor.

Despite the prime position Chemistry occupies in the Nigerian educational system and the efforts made by teachers and educators to enhance performance in Chemistry, students continue to show weakness in the knowledge and understanding of chemical concepts, leading to poor academic performance. In an attempt to enhance Chemistry students' performance, a video-based micro-learning strategy was adopted in this study. Every science subject has two parts, the practical and theoretical aspects. The essence is to provide both inquiry laboratory experience and theory experience to the students, thereby making science interesting. Most often, Chemistry teachers use the lecture method to teach every topic in Chemistry, giving lengthy notes without a positive impact on students' cognition and affection.

Video-based micro-learning strategy is a teaching strategy in which information is broken down into smaller, easily digestible chunks and delivered in less than ten minutes per session in the form of video clips. Video-based micro-learning strategy ensures better information retention, increases learners' engagement, encourages learning on the go through mobile learning, enables personalized learning, and supports self-paced learning (Bray, 2019). According to Calinton (2022), micro-learning is already taking place through YouTube shorts, Instagram and Facebook reels, and TikTok. This trend is among the significant emerging trends in educational technology that will grow in 2025 and beyond. The researchers adopted this strategy by breaking down lessons on acid-base titration into small, manageable, and focused units in a video format. This approach enhances student engagement and retention by allowing for flexible and personalized learning experiences.

The integration of educational technologies into the 21st-century classroom prepares both teachers and students for the challenges and opportunities that are available in society. Students' motivation and information retention, as well as their ability to do research work in a team, also increase. The use of technological tools for teaching allows individualization of learning and encourages students to seek out the content they like. Students use information online or in a traditional classroom with their teachers and colleagues in order to learn new lessons. There is therefore a wide gap to be filled on the use of technology such as video-based instructional packages to support instructional strategies. The use of a video-based instructional package in micro-learning is an innovation. Sequel to this, the study investigated the effect of a video-based micro-learning strategy on secondary school Chemistry students' performance in Acid-Base Titration in Imo State

Statement of the Problem

Underperformance of Chemistry students in external examinations in Imo State and Nwangele Local Government Area, in particular, has remained worrisome to parents and educators. The use of inappropriate instructional strategies by Chemistry teachers has been widely reported as one of the major factors contributing to the poor performance of students in external examinations (Esogwa, 2021). These inappropriate instructional strategies do not encourage interest in learning Chemistry concepts; rather, students struggle to memorize concepts only to forget them shortly afterwards. Research findings have also shown that inadequate exposure of the students to laboratory practical exercises has been one of the factors that lead to poor performance in Chemistry (Ehirim, 2020). The problem of poor Chemistry performance in the West African Examinations Council (WAEC) may not be far from the method of presenting the content.

This ugly situation prompted Okebukola (2014) to frown at the quality of science education in Nigeria, describing it as way below the mark. Sequel to this, this paper adopted a strategy of delivering instruction in Chemistry by exposing SS2 students to innovative and interactive instructional strategies, such as a video-based micro-learning strategy, with the view of enhancing students' performance in acid-base reactions.

Aim and Objectives of the Study

The study aimed to determine the effect of a video-based micro-learning strategy on secondary school Chemistry students' performance in Acid-Base Titration in Imo State. Specifically, the objectives of the study are to:

1. Assess the academic performance of students when taught acid-base titration using a video-based micro-learning strategy
2. Compare the academic performance of male and female students when taught acid-base titration using a video-based micro-learning strategy

Research Questions

The study sought to answer the following questions

1. What is the academic performance of students taught acid-base titration using a video-based micro-learning strategy and a lecture method?
2. What is the academic performance of male and female students taught acid-base titration using a video-based micro-learning strategy and a lecture method?

Hypotheses

Two null hypotheses were formulated and tested at a 0.05 significance level in this study

7. There is no significant difference between the academic performance of students taught acid-base titration using a video-based micro-learning strategy and those taught using the lecture method
8. There is no significant difference between the academic performance of male and female students taught acid-base titration using a video-based micro-learning strategy and those taught using the lecture method

Methodology

The study employed a quasi-experimental design involving pretest and posttest non-equivalent groups. Two groups (experimental and control) from two co-educational schools were used**.** One hundred and five (105) Senior Secondary Two (SS2) Chemistry students participated in the study. Acid-Base Titration Performance Test (ABTPT), containing 20 objective questions, was used to gather data after thorough validation with a reliability index of 0.76 using Pearson Product Moment Correlation by two experts in the Department of Curriculum Studies and Instructional Technology, Ignatius Ajuru University of Education, Rumuolumeni, Port Harcourt, Rivers State. The experimental group was taught using a video-based micro-learning strategy while the control group was taught using the lecture method. Data obtained were analyzed using mean and standard

deviation to answer the research questions, while ANCOVA was used to test the hypotheses at a 0.05 significance level.

Results

The results are presented in the following tables

Research Question One: What is the academic performance of students taught acid-base titration using a video-based micro-learning strategy and a lecture method?

Table 1: Mean and Standard deviation of pre-test and post-test performance of students using Video-Based Micro-learning Strategy and Lecture Method (LM)

Group	N	Pre-test	SD	Post-test	SD	Mean Gain
VBMLS	54	40.52	2.49	64.80	5.573	24.28
LM	51	42.30	3.52	56.90	4.60	14.6

*VBMLS = Video-Based Micro-learning Strategy, LM = Lecture Method

From Table 1, it was clear that students taught acid-base titration using a video-based micro-learning strategy had a score of 40.52 before treatment administration, while after treatment, their post-test score was 64.80. For students in the control group who were taught using the lecture method, their pretest mean performance was 42.30, while their post-test mean performance was 56.90. This result revealed that the mean gain for students in the experimental group was 24.28, while for the control group it was 14.6. These results suggested that students' result in Chemistry (acid-base titration) was greatly enhanced by using a video-based micro-learning strategy than the lecture method.

Research Question Two: What is the academic performance of male and female students taught acid-base titration using a video-based micro-learning strategy and lecture method?

Table 2: Mean and Standard deviation of pre-test and post-test performance of male and female students taught using video-based micro-learning strategy

Group	Gender	Pretest	SD	Posttest	n	SD	Mean Gain
VBMLS	Male	38.62	3.03	62.22	26	5.01	23.60
	Female	43.12	4.88	66.90	29	6.33	23.78

From the result on Table two, it was also clear that male students taught using video-based micro-learning strategy had pretest and posttest mean performance of 38.62 and 62.22 respectively, resulting in a mean gain of 23.60, while female students taught with the same strategy had pretest and posttest mean performance of 43.12 and 66.90 respectively which implies a mean gain of 23.78. Video-based micro-learning strategy enhanced the performance of female students in Chemistry (acid-base titration) than male students.

Hypothesis One

There is no significant difference between the academic performance of students taught acid-base titration using a video-based micro-learning strategy and those taught using the lecture method

Table 3 Analysis of Covariance of Performance of students taught acid-base titration using video-based micro-learning strategy and those taught using the lecture method

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	1502.556[a]	2	751.28	20.38	.000
Intercept	2212.39	1	2212.39	60.02	.000
PreP	120.68	1	120.68	3.27	.073
Group	1444.24	1	1444.24	39.18	.000
Error	3870.21	103	36.86		
Total	42521.00	105			
Corrected Total	5372.77	101			

The result in Table three revealed that the F-value of 39.183 obtained at 1 and 101 degrees of freedom had an associated p-value of .000, which is less than the chosen alpha of 0.05; it can be stated that Video-based micro-learning had a significant effect on the mean performance of students taught acid-base titration in Chemistry. The null hypothesis was therefore rejected

Hypothesis Two

There is no significant difference between the academic performance of male and female students taught acid-base titration using a video-based micro-learning strategy and those taught using the lecture method

Table 4 Analysis of Covariance of Performance of male and female students taught acid-base titration using video-based micro-learning strategy

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	99.649[a]	2	24.91	.518	.723
Intercept	2493.33	1	2493.34	51.86	.000
Pre-testP	38.74	1	38.72	.81	.372
Group	22.32	1	22.32	.46	.497
Gender	4.68	1	4.67	.09	.756
Group * Gender	39.22	1	39.22	.82	.368
Error	5144.27	53	48.08		
Total	57145.00	54			
Corrected Total	5243.92	52			

Table 4 shows the Summary of ANCOVA on the performance of male and female students taught Chemistry using a video-based micro-learning strategy. There was no significant difference between the performance of male and female students taught (acid-base titration) Chemistry using a video-based micro-learning strategy (P=.368 > 0.05). The null hypothesis was accepted at a 0.05 significance level.

Discussion of Finding

Results in Table 1 showed that the video-based micro-learning strategy had a significant effect on students' performance in teaching acid-base titration in Chemistry compared with the lecture method. The result in Table 3 revealed that the video-based micro-learning strategy had a significant effect on the mean performance of students taught (acid-base titration) in Chemistry. This result is in agreement with the findings of Abraham (2021), who showed that senior students taught using a video-based micro-learning strategy had higher academic performance in mean scores than those taught using the discussion method. Video-based micro-learning strategy allowed students to learn by constructing their knowledge. Also, findings of Egwim (2020) agreed that students performed better when taught with a micro-learning strategy than the lecture method

From the results in Table 2, it was observed that the video-based micro-learning strategy had a greater effect on the performance of female students in Chemistry than male students. Table 4 showed that there was no significant difference between the performance of male and female students taught Chemistry using a video-based micro-learning strategy. This finding is in agreement with the study of Pedro (2020), who found that being a male or female does not affect students' academic performance when taught using the same teaching strategy. However, the present finding contradicts the earlier findings of Bello (2016), who found that gender has a significant effect on students' academic performance when taught using the same interactive teaching strategy.

Conclusion

The study investigated the effect of a video-based microlearning strategy on the performance of secondary school Chemistry students in Acid-Base Titration in Nwangele Local Government Area, Imo State. The study is an extension of the use of 21st-century innovative, digital, and learner-centered instructional strategy that encourages active participation, active knowledge construction, higher-level thinking skills of students, and engagement. The study showed that a video-based micro-learning strategy is more effective than the lecture method (LM) in understanding acid-base titration in Chemistry. The lecture method was found to be weak in enhancing students' performance in the subject. The study also provided empirical proof on the relative effectiveness

of digital and interactive strategies in enhancing the teaching and learning outcomes in Chemistry. Based on the findings of the study, it was concluded that the use of a video-based micro-learning strategy has a significant effect on the students' academic performance.

Recommendations

The study recommended that:

1. Teachers should adopt a video-based micro-learning strategy to enhance students' academic performance in acid-base titration. Chemistry
2. Chemistry teachers on the job should be retrained to improve on this innovative and interactive method of instruction, especially in teaching acid-base titration

References

Abraham, A.O. (2021). Gender balancing in science education (GBSE): What is the way forward: *Journal of Science Education, 3(2&3), 12-20.*

Bello, U.J. (2016). Effect of micro-learning strategy on students' performance in redox titrations among SS2 secondary school students, *Journal of Science Education, 32 (12), 5 1-58*

Bray, B.K. (2021). Effect of micro-learning and demonstration strategies on senior secondary school students' performance in chemistry in Rivers State. *Journal of Science and Technical Education, 32 (12), 5 1-58.*

Calinton, C.L. (2021). Effect of cooperative learning approach on chemistry students' academic performance and retention in electrolysis in Osun State. *Technology Education Journal, 3*(2), 29-38

Egwim, M.O. (2020). Impact of guided inquiry strategy on teaching Sciences in secondary schools in Nigeria. *Journal of Science Education, 2 (2) 15-17.*

Ehirim, J. (2020). Innovative and learner-centred teaching methods for teaching chemistry at the secondary schools in Nigeria. *Social Science and Management, 12* (3), 6-15.

Esogwa (2021). Esogwa, C.M. (2015). Effect of activity based approach on chemistry students' academic performance in Imo State. *International Journal of Education, 5* (4), 12-21.

Idris, A.O. (2021). Effect of cooperative learning on chemistry students' performance and interest level in titration in secondary schools in Edo State. *International Journal of Research in Education, 4(2), 27-41*

Isidor, O. A. (2019). Improving students' performance and attitude in chemistry practical through problem solving techniques. *Journal of Science Development, 1* (1), 20-32

Kalu, O. (2020). Effect of inquiry-based learning on mathematics students' performance in Nigerian secondary schools. *Journal of Technical Education, 2* (2), 65-72.

Nkemka, S. (2021). Effect of guided inquiry learning on SS2 physics students' performance and retention in Imo Sate. *Journal of Educational Issues, 30* (2), 44-57.

Nwafor, L.C., & Osuala, R.O (2024). The use of artificial intelligence (AI) in Think-pair-share instructional strategy for enhancement of biology students' performance in Rivers State. *Journal of National Association of Social Reviewers (NASTs), 15* (3), 154-160

Okebukola, P. (2014). Quality of science education in Nigeria: A speech presented at the 55th annual conference of Science Teachers Association of Nigeria, 2014 at Asaba, Delta State, Nigeria.

Pedro, J.L. (2020) Effect of use of demonstration method on academic performance of high school chemistry students in Imo State. *Journal of Information Technologies, 2(3), 10-21.*