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RESEARCH

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Effectiveness of Hypermedia and Multimedia Learning Strategies on the Academic Performance of Chemistry Students in Nigeria

Skuteczność wykorzystania hipermediów i multimedialnych strategii uczenia się na poziomie akademickim studentów chemii w Nigerii

Introduction

Chemistry is one of the core science subjects taught in Nigerian high schools (FGN, 2014). It is central to many science subjects and disciplines such as medicine, nursing, engineering, pharmacy, agriculture, geology and so many others. Obviously, no student intending to explore these disciplines can be successful without adequate knowledge of chemistry. Chemistry teaching is therefore indispensable in the study of many disciplines which will invariably ensure sustainable national development. The objectives of teaching chemistry at high school level are set forth in the National Policy on Education (FGN, 2014), reinforced by examination bodies, namely West African Examination Council (WAEC, 2013), a curriculum development body, such as Nigerian

Educational Research and Development Council (NERDC, 2008), as well as National Examination Council (NECO, 2013). These objectives are seen in terms of the contribution of chemistry to the realization of secondary education in Nigeria which include: understanding of basic chemistry concepts; acquisition of laboratory skills, including the awareness of hazards and safety measures; awareness of the correlation between chemistry and other disciplines; awareness of the linkage between chemistry and industry/ environment/everyday life in terms of benefits and hazards to develop the skills of critical and logical thinking, and to develop reasonable information communication technology appliances that will engender entrepreneurial skills. The statistics regarding the results of students' performance in chemistry in West African Senior Secondary School Certificate Examination (WASSSCE) of six consecutive years indicated that students who passed chemistry at credit level and above i.e. (A1-C6) had consistently being less than 50% (WAEC Chief Examiner's report, 2010-2015). Various efforts at improving chemistry education appear to be inadequate as reflected by persistent poor performance of students within this field of science (Nonyelum, 2015).

Chemistry is an experiment-based science subject, so practical work is very much an integral part of the course and one of the key aims of the practical course is to develop the skills that an accomplished practical chemist needs (Natural Science Tripos, 2015). Scientist acquires and sustains knowledge through experimentation (practical) (Achor, Kalu, 2014). It has generally been observed that students performed poorly in practical chemistry (Achor, Kurumeh& Orokpo, 2012). It follows therefore that an understanding of a concept in practical chemistry will assist in enhancing student's understanding of the subject (Ikeobi, 2010). Omolade (2008) states that if the academic achievement of students is to be enhanced, learners should thoroughly understand of basic concepts behind a practical task they engage in. This is because the observations and experiments students carry out are meant to confirm some theories and the application of concepts. The poor performance in chemistry can cripple the realization of national goals for scientific and technological development (Njoku and Ezinwa, 2014).

Some of the reasons identified for abysmal poor performance include, among others: laboratory inadequacy, teachers' attitude, abstract and difficult nature of many chemistry concepts, lack of instructional materials, examination malpractice, time constraint for practical classes, non-coverage

of syllabus, class size, lack of professionalism, environment, poor methods employed by most chemistry teachers as well as lack of interest among chemistry students (Njoku& Nwagbo, 2014 and Jegede, 2007). Aluko (2008) and Salau (2012) both considered poor instructional delivery approaches as one of the major factors contributing to the persistent poor performance of the students. In a similar vein, the West African Examination Council (WAEC) Chief Examiners Report (2006–2010) and a study by Eze and Egbo (2007) have attributed the observed student poor achievement in chemistry to use of inappropriate and ineffective teaching methods by chemistry teachers. All other factors mentioned as to the reasons for poor science process skills and achievement hinge on teacher's method of instruction delivery. Consequently, research results have shown that the use of innovative teaching methods, such as multimedia and hypermedia instructional strategy, could enhance science process skills acquisition and achievement in science, including chemistry (Osman and Vebrianto, 2013). Kumar (2013) asserted that multimedia are instructional materials and interactive applications that integrate text, colour, graphic images, audio, animation, audio sound, and full motion video in a single application. Oshinaike and Adekunmisi (2012) opined that multimedia could be interpreted as a combination of data carriers, such as video, CD-ROM, floppy disks, Internet and software in which the possibility for an interactive approach is offered. Salisu (2015) argued that multimedia approach can be used in teaching subjects like geography, biology, chemistry, physics, and mathematics among others.

Hypermedia is associated with animation, graphics and texts. It is effective and can attract the learners to explore the content (Suhaila& Nazri, 2010). Hypermedia is the most suitable media type for learners as it is capable of enhancing their understanding, especially regarding abstract concepts such as external landform processes. A study conducted by American memory examined the influence of hypermedia; the literature revealed that hypermedia enhances learning through motivation, retention, understanding, enjoyment, self-direction, interest and knowledge construction. Mweri (2014) reports that poor academic achievement has been linked, among others, to factors such as motivation, understanding, inappropriate teaching methods. The art of teaching is to involve the learners in their active learning process by offering many different kinds of learning media. This is in line with constructivism theory which stipulates that the best way of learning is by allowing learners to

construct meaning (Arends, 2010). Students can customize a learning plan that helps them remember rather than resort to the adapted traditional technology which emphasizes memorization and imitation more.

A multimedia and hypermedia aided instruction engaged the students' interest and encouraged them to collaborate, inquire and explore effectively, far beyond the bounds of school (Galope, 2013). Hashim, Tasirand Mohamad (2013) pointed out that problems that hard-of-hearing students face in the traditional classroom provide opportunities for the hypermedia movement. With multimedia, the communication of information can be done in a more effective manner and it can be an effective instructional medium for delivering information. According to Gaytan and Slate cited in Chapman (2013), the use of multimedia in teaching and learning processes has the potential to improve instruction by creating a technology-based, student-centered learning environment that allows students to take charge of their own learning. Lecture method as an instructional strategy is commonly used because it aids early coverage of course outline, saves time and does not require the use of laboratory material (Mohammad, 2014). Science education emphasizes the teaching and learning of science processes and principles. This, in turn, will lead to fundamental and applied research in science at all education levels (FGN, 2014). Science process skills are practical chemistry skills.

The Nigerian Educational Research Council cited in Nwagbo and Chukelu (2011) modified and came up with fifteen (15) science process skills. These are: observing, classifying, predicting, using numbers, questioning, defining operationally, hypothesizing, interpreting data, measuring, communicating, inferring, using space/time relationship, controlling variables, formulating models, designing an experiment. Science process skills are inseparable in practice from the conceptual understanding that is involved in learning and applying science (Karamustafaoglu, 2011). Ibrahim (2012) opined that the acquisition of science process skills can be achieved through hands-on activity-based teaching method such as the laboratory method and the use of multimedia instructional tools. Also, Achimugwu (2011) opined that some of these process skills can be acquired through qualitative analysis aspect of practical chemistry where tests are carried out to identify an unknown component of a salt sample. Research on the use of multimedia for teaching chemistry at senior secondary school level in Nigeria is scarce (Onasanya, Fakomogbon, Shehu &Soetan, 2010; Nwana, 2012). Little is known about the use of multimedia instructional packages in the Nigerian education,

particularly in learning some practical chemistry concepts and processes. Much remains to be empirically researched on the effect of multimedia and hypermedia instructional strategies in facilitating the effective learning of chemistry and other science subjects. At the same time, it should be attempted to determine the effect both learning strategies are likely to have on students' performance in science in comparison with the use of traditional methods.

Statement of the Problem

The world is technology driven and the introduction of learning technologies has changed the ways students learn in the classroom and even outside of it. Traditional education methods requiring the student to learn through memorization of facts have become inadequate for modern-day learning as they are not interactive enough to facilitate effective knowledge acquisition. There is a need to shun this teacher-centered approach and embrace students–centered strategies that allow students to explore the learning process in their own manner. In the current digital age there are so many technologies available for students to facilitate learning. New learning technologies which focus on the use of modern ICT-driven instructional strategies should thereby be employed by teachers in order to keep contemporary learners in tune with the world and to enhance their performance and relevance in the world they live in. This study, therefore, examined the effectiveness of hypermedia and multimedia learning strategies on the academic performance of chemistry students in Nigeria.

Purpose of the Study

The major purpose of this study was to examine the effectiveness of hypermedia and multimedia learning strategies on the academic performance of chemistry students in Nigeria. Specifically, the study was carried out to:
1) Find out if hypermedia learning strategy would improve the academic performance of chemistry students.
2) Determine if multimedia learning strategy would improve the academic performance of chemistry students.
3) Ascertain if gender has any significant effect on the academic performance of chemistry students exposed to the two learning strategies.

Hypotheses

1) There is no significant difference in the academic performance of chemistry students exposed to hypermedia strategy and the control group
2) There is no significant difference in the academic performance of chemistry students exposed to multimedia learning strategy and the control group
3) There is no significant difference in the academic performance of chemistry students exposed to the learning strategies based on gender.

Methodology

The research design used for this study was a quasi-experimental research design of the pre-test, post-test, control group design. A purpose sampling technique was used to select twenty students from four high schools within the Osogbo area of the Osun state. Students who are well acquainted with the use of technology for learning vis-a-vis possession of ICT knowledge were purposively selected. The number of these students was further narrowed down to ten per school due to the limited quantity of the instructional packages through which these learning strategies were delivered to the learners.

The sample respondents were selected from high schools within the Osogbo central area of the Osun state in Nigeria. There were two experimental groups: "H" and "M", as well as a control "C" group. Students in the experimental group H were exposed to hypermedia learning strategy through the use of hypermedia instructional package, while those in experimental group M were exposed to multimedia learning strategy by interacting with a multimedia package. Students in the control group were given selected chemistry textbooks to read in a monitored environment and guided format. All respondents were subjected to a pre-test in chemistry.

All research instruments were validated by two academics in the chemistry department of the Osun state university, two learning technology experts with background knowledge of science, as well as some experienced graduate teachers in some of the schools not too far away from the schools selected for the research. All adjustments pointed out were made. During pilot testing through test-retest on 20 chemistry students in another school which was not part of the

study, the reliability of the instruments was tested. Pearson product moment correlation gave the reliability coefficient of the test as 0.79. The hypermedia instructional package had a reliability index of 0.83, while a reliability index of 0.75 was obtained for the multimedia package. Data gathered after the administration of learning strategies through the instructional packages were analyzed using descriptive statistics and ANCOVA

Results

The results of the study are as follows:

Hypothesis 1: There is no significant difference in the academic performance of chemistry students exposed to hypermedia strategy and the control group.

Table 1. Tests of Between Subjects Effects Hypermedia Learning Strategy Dependent Variable: Post test

Source	Type III Sum of Squares	df	Mean Square	F	sig.	Partial Eta Squared
Corrected Model	1095.284(a)	2	547.642	99.341		
Intercept	172.542				.000	921
Pretest	.084	1	172.542	31.299	.000	.648
Group	911.843	1	.084	.015	.903	.001
Error	93.716	1	911.843	165.407	.000	.907
Total	32394.000	17	5.513			
	11	20				
Corrected Total	89.00	19				

a R Squared = -9.21 (Adjusted R Squared = -.912)

Table 1. presents a significant correlation between the hypermedia strategy group and that of the control group. The null hypothesis is rejected and the alternative one is accepted: that there is a significant difference in the academic performance of chemistry students exposed to the hypermedia strategy than those that were not.

Table 2. Estimated Marginal Means [Hypermedia Learning Strategy Group]
Dependent Variable: Post-test

Group	Mean	Std. Error	95% Confidence	
	Lower	Upper	Lower Bound	Upper Bound
Hypermedia Learning Strategy Group	46.872(a)	.777	43.232	48.512
	32.128(a)	.777	30.488	33.768

It is revealed in Table 2 that the estimated marginal mean for H was 46.872 as compared with the value of 32.128 for the control group when subjected to treatment. Standard error was observed at a value of 0.777. The result signifies a positive significant correlation between hypermedia learning strategy and academic performance of chemistry students. The null hypothesis 1 is thus rejected.

Hypothesis 2: There is no significant difference in the academic performance of chemistry students exposed to multimedia learning strategy and the control group.

Table 3. Tests of Between Subjects Effects Multimedia Learning Strategy Dependent Variable: Post test

Source	Type III Sum of Squares	df	Mean Square	F	sig.	Partial Eta Squared
Corrected Model	1240.850 (a)	2	620.42	105.367	.000	.925
Intercept	307.45	1	307.45	52.215	.000	.754
Pretest	8.40	1	8.400		.249	.077
Group	1237.034	1	1237.0	210.085	.000	.925
Error	100.100	17	5.888			
Total	32421.000	20				
Corrected Total	1340.950	19				

a R Squared = .925 (Adjusted R Squared = -.917)

Data in table 3 shows that the independent variable is equal across groups, thus the ANCOVA was carried out and was used to deduct the effect between subject which is the multimedia learning strategy group and the control group.

Table 4. Estimated Marginal Means [Multimedia Learning Strategy Group]
Dependent Variable: Post-test

Group	Mean	Std. Error	95% Confidence	
	Lower	Upper	Lower Bound	Upper Bound
Multimedia Learning	47.990(a)	.771	46.363	49.617
Strategy Group	32.110(a)	.771	30.483	33.737

Table 4 shows that the estimated marginal mean for the Multimedia Learning Strategy was 47.990 while that of the control group amounted to 32.110 when subjected to treatment at 0.771 standard error. Thus, there is a positive correlation between multimedia learning strategy and academic performance of chemistry students. Hypothesis 2 is therefore rejected.

Hypothesis 3: There is no significant difference in the learning outcomes of chemistry students exposed to the learning strategies based on gender.

Table 5. Learning Strategies across Gender

		N
Gender	Male	20
	Female	20

Table 6. Levene's Test of Equality of Error Variances (a) Dependent Variable: Posttest

F	df1	df2	Sig.
005	1	9	.942

Table 6 implies that the co-variance is not significantly related to the dependent variable. Thus, there is a correlation between students' performance and their gender.

Discussion of Findings

The findings of this study revealed significant differences in the post-test scores of students exposed to the two learning strategies. This signifies that the treatment resulted in better student performance in chemistry. The post-test scores of students exposed to both packages could have been due to the sole amount of enhanced and more effective learning strategies produced by the two instructional packages which has made learning more fascinating and engaging

to students. This is because the instructional packages motivated the students to learn. The study also revealed that male chemistry students performed quite better than their female counterparts when exposed to hypermedia and multimedia learning strategies. The findings above are supported by the claim of Galope (2013), stating that multimedia and hypermedia aided instruction is beneficial as it engages students' interest, and encourages them to collaborate, enquire, and to explore effectively, far beyond the bounds of school. The findings are also in line with Gaytan and Slate cited in Chapman (2013) who stated that the use of multimedia in teaching and learning processes has the potential to improve instruction by creating a technology-based, student-centered learning environment that allows students to take charge of their own learning.

Conclusion

The conclusion of this study is premised on the discussion and study findings. The use of both hypermedia and multimedia learning strategies were found to be more effective in enhancing students' performance in chemistry. This is an indication that students' academic performance improved significantly when such learning strategies were employed, since both learning strategies allow learners to explore and enjoy learning with the use of far more individualized and interesting platforms.

Recommendations

1. Chemistry teachers and instructors should be implored to employ modern learning strategies for proper motivation of their learners.
2. Students should be encouraged and motivated to learn through modern learning strategies.
3. School authorities should strive to provide modern, technology driven learning strategies to boost teachers' will to learn and encourage students to learn.
4. Relevant stakeholders and non-governmental organizations should organize regular workshops, seminars and special training for Chemistry instructors and teachers on the effective use of these technology driven learning strategies.

Abstract: The conventional approach to teaching has led to poor performance of students in chemistry and some other subjects. Research has shown that students would learn better should they participate in the teaching-learning process. This study determined the effectiveness of hypermedia and multimedia learning strategies in the academic performance of chemistry students in Osogbo, Nigeria. The pre-test, post-test, control group quasi-experimental design was adopted for this study. Forty students from four schools within the Osogbo central area in Nigeria participated in this study. The instruments used for data collection were: Hypermedia Instructional Package, Multimedia Package and Chemistry Students Achievement Test. Three null hypotheses were tested at 0.05 significance level. Data collected were analyzed using Analysis of Covariance (ANCOVA). Treatment had a significant effect on chemistry students' post-test achievement scores. Students exposed to learning strategies performed better, with higher adjusted post-test mean score, in comparison with their counterparts who were not exposed to any of the two learning strategies.

Keywords: conventional approach, hypermedia, multimedia, achievement scores, achievement test

Streszczenie: Konwencjonalne podejście do nauczania doprowadziło do słabych wyników uczniów w zakresie chemii i niektórych innych przedmiotów. Badania wykazały, że uczniowie uczyliby się lepiej, gdyby uczestniczyli w procesie nauczania i uczenia się. Badania te określiły skuteczność hipermedialnych i multimedialnych strategii uczenia się w osiągnięciach akademickich studentów chemii w Osogbo w Nigerii. Do tego badania przyjęto projekt pre-test, post-test, grupy kontrolnej quasi-eksperymentalnej. W badaniu tym wzięło udział czterdziestu studentów z czterech szkół z centralnego obszaru Osogbo w Nigerii. Do zbierania danych wykorzystano następujące narzędzia: Hipermedia Instructional Package, Multimedia Package oraz Test Osiągnięć Uczniów Chemii. Trzy hipotezy zerowe zostały przetestowane na poziomie istotności 0,05. Zebrane dane analizowano za pomocą Analizy Kowariancji (ANCOVA). Postępowanie terapeutyczne miało istotny wpływ na wyniki studentów chemii po teście. Uczniowie poddani działaniu strategii uczenia się osiągali lepsze wyniki, z wyższymi skorygowanymi średnimi wynikami z testów, w porównaniu z ich odpowiednikami, którzy nie byli poddani żadnej z dwóch strategii uczenia się.

Słowa kluczowe: podejście konwencjonalne, hipermedia, Multimedia, wyniki osiągnięć, test osiągnięć

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