

DIGITAL TOOLS UTILIZATION AND CHEMISTRY STUDENTS' ACADEMIC ACHIEVEMENT IN THE TEACHING OF SOAP PRODUCTION IN SECONDARY SCHOOLS IN AKWA IBOM STATE, NIGERIA

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Abstract

Digital tools in the classroom is nothing new to education. Pioneers in its use in education have much to teach us to enable student acquire knowledge and skills necessary to survive in a digital world. This study investigates digital tools utilization and Chemistry students' academic achievement in the teaching of soap production in secondary schools. The design was a pretest, posttest quasi-experimental design. The population comprised all the 3840 Chemistry students in the 14 public secondary schools of which 100 students were selected from two intact classes by criterion sampling techniques. Achievement Test on Soap Production (ATSP) was used to collect data with a reliability of 0.78 determined by Kuder Richardson test. Mean and standard deviation were used to answer research questions, while independent T-test was used to test the hypotheses at $p \leq .05$ level of significance. Findings of the study showed that students taught with digital tools performed better than those taught with expository method. There was a significant difference in their achievement mean scores. But there was no significant difference between male and female students' achievement mean scores. It was therefore concluded that the utilization of digital tool was effective in teaching soap production. It was recommended that Chemistry teachers should be encouraged to adopt the use of digital tools such as computers in the teaching. Conferences, seminars and workshops should be organized for teachers to acquaint them with latest digital tools to improve the teaching of soap production and other concepts.

Key words: Digital tools, Utilization, Chemistry, Academic achievement and Soap Production

Introduction

The utilization of digital tools holds global significance and is applicable in all aspects of life. These tools functionally offer a medium for the incorporation of text, images, audio and video files for educational purposes. These computer-based resources are employed by individuals to cater to the information and communication processing requirements of organizations. Digital tools encompass computer hardware and software, as well as

networks and other multimedia devices like video, audio, phone, and camera, which convert information into text, sound, and motion.

The utilization of digital tools encompasses a variety of shapes and sizes, each serving a specific purpose. Notably, among the selection of portable digital tools are Google Chrome books and iPads, which have the versatility to be utilized in both online and classroom activities. Other portable digital tools include computers, clickers, SMART boards and projectors which are implemented for information dissemination, teaching, and learning. The use of computers as digital tools offers students an opportunity to cultivate and apply higher-level thinking skills to address problems that are pertinent to their daily lives. Hillmayr *et al.*, (2020) reiterated that digital tools can enhance students' understanding through interactive and multimedia learning content. Amhag (2017) asserts that digital tools can facilitate teacher-student engagement and motivation across various concepts, making mobile assisted instruction effortless during learning activities

The academic performance of Chemistry students has been comparatively inadequate. Lack of qualified teachers (Okwuduba, 2018); attitudes or personal fears (Wilson *et al.*, 2020; Njiku, 2022); teachers' lack of proficiency in deploying cutting-edge learning tools, including computers, tablets, projectors, and smart boards (Walkowiak & Nehring, 2016) has been identified as the cause of students' poor academic outcomes. This trend of substandard academic performance in the field of Chemistry, coupled with the high failure rate, if not checked, could potentially jeopardize the scientific and technological advancement of the nation. To minimize the failure rate in Chemistry, Coulter, (2019) and Olatunji (2015) suggests that science teachers must undergo appropriate training and retraining, modern laboratory facilities must be adequately provided, and better learning strategies should be embraced.

The teaching of the Chemistry curriculum to students includes the fundamental concept of soap production. Soap is obtained through the hydrolysis of naturally occurring fats and oils using either sodium hydroxide or potassium hydroxide, and it serves as an essential cleaning agent for everyday use. The process of producing soap, known as saponification, is a significant aspect of chemical industrial production. The utilization of digital tools may facilitate students in acquiring the necessary knowledge and practical skills required to thrive in a complex, highly technological, knowledge-based economy.

Gender is a moderating factor that has been examined in this study. A number of studies have demonstrated the discrepancy between male and female students. Ajayi & Ogbeba (2017) and Udu (2018) observed that the interaction between methodology and gender has no significant impact on students' achievement in science. Additionally, Ekon & Amanso (2015) demonstrated that there is no significant difference in the achievement of male and female students in science. While Eden & Mbuk (2019) and Etiubon (2011) observed that female students performed significantly better than their male counterparts in Chemistry. To this end this study sought to investigate the impact of digital tool utilization on students' academic achievement and the moderating effect of gender on learning outcomes.

Statement of Problem

The inadequate performance of students in the Senior School Examination and National Examination Council in Chemistry highlights the possibility of inappropriate instructional

strategies employed by teachers and inadequate acquisition of economically useful skills by the students. This setback may result in a decline in the number of students pursuing higher studies in Chemistry and hinder their ability to become self-reliant, ultimately leading to a shortage of skilled manpower in various sectors of the economy. The use of digital tools has significantly enhanced educational outcomes in various aspects of human life and has become an integral part of the academic landscape. Although previous studies have focused on the use of digital tools to improve students' academic performance, none have addressed the learning of soap production, which is an essential commodity in every household. To examine the effects of digital tool utilization on students' academic achievement, a study involving the use of digital tools and expository teaching method to learn soap production was conducted.

Purpose of the Study

The purpose of study was to examine the digital tools utilization and Chemistry students' academic achievement in the teaching of soap production in secondary schools in Akwa Ibom State, Nigeria. Specifically, the study sought to determine:

1. production in secondary schools when taught using digital tools and those taught with expository method?
2. The difference between male and female Chemistry students' academic achievement in soap production in secondary schools when taught using digital tools and those taught with expository method?

Research Questions

1. What is the difference between Chemistry students' academic achievement in soap production in secondary schools when taught using digital tools and those taught with expository method?
2. What is the difference between male and female Chemistry students' academic achievement in soap production in secondary schools when taught using digital tools and those taught with expository method?

Hypotheses

The hypotheses were tested at .05 level of significance.

1. There is no significant difference between Chemistry students' academic achievement in soap production in secondary schools when taught using digital tools and those taught with expository method.
2. There is no significance difference between male and female Chemistry students' academic achievement in soap production in secondary schools when taught using digital tools and those taught with expository method.

Scope of the study

The study focused on the utilization of digital tools in secondary school Science teaching of soap production. The sample was selected secondary schools in Uyo Local Government Area of Akwa Ibom State. The study covered all the students in the 14 secondary schools in Uyo Local Government. This is because attempt to all the secondary schools in Nigeria will be futile due to limited resources therefore the research work was limited to its present

scope. The study was limited to Chemistry students in the senior secondary schools of the selected secondary schools in Uyo Local Government of Akwa Ibom State.

Methods

The design adopted for the study was pretest, posttest experimental control group design. The population of the study comprised all the 3840 Chemistry students in the 14 public secondary schools in Uyo Local Government Area of Akwa Ibom State. The sample of the study was 100 students drawn by simple random sampling technique from two schools in two intact classes by criterion sampling technique.

A researcher made instrument was used for data collection. It was a twenty-five item Achievement Test on Soap Production (ATSP) with 1 correct answer and 3 distractors scored 1 and 0 respectively. Instrument validation was done by three senior lecturers and above in the Department of Science Education, Physical Sciences and Measurement and Evaluation Unit all from Akwa Ibom State University. The reliability of the instrument was 0.79 determined by Kuder Richardson test.

The ATSP was administered as pretest to ascertain students' entry behaviour before the commencement of the treatment using prepared lesson packages tailored according to the variables considered in the study experimental and control groups. The experimental groups were taught using digital tools of computer laptop with videos downloaded from the internet under the following headings: nature and chemical composition of soaps, laboratory preparation of soaps, production of local soaps and cleansing action of soap, hard water and soap, detergents (soapless) and soap versus soapless detergents according to the senior secondary chemistry curriculum. The researcher gave room for discussions, student's activities, questions and answer sessions while the control group were taught using expository method. After two weeks of treatment, a post test was administered to the two groups to ascertain the level of knowledge gained. Data obtained were analysed using descriptive statistics of mean and standard deviation and independent T-test was used to test the hypotheses.

Results

Research Question one

What is the difference between Chemistry students' academic achievement in soap production in secondary schools when taught using digital tools and those taught with expository method?

Table 1: Mean and standard deviation of students' pretest and posttest achievement mean scores in soap production in secondary schools when taught using digital tools and those taught with expository method

Groups	N	Pretest		Posttest		Mean Gain
		Mean	SD	Mean	SD	
Experimental	50	7.04	1.64	18.24	2.02	11.20
Control	50	7.22	1.87	15.64	2.66	8.42

Results in Table 1 shows the mean difference (posttest-pretest mean scores) for the experimental and control groups to be 11.20 and 8.42 respectively. This result indicates that students taught soap production with digital tools performed better than those taught with expository method. Table 1 also showed that the standard deviation of students taught soap production using digital tools and those taught with expository methods is 2.02 and 2.66 respectively. This indicates that the scattering of scores from the mean scores of students taught soap production using digital tools were higher when compared to those taught with expository method.

Research Question Two

What is the difference between male and female Chemistry students' academic achievement in soap production in secondary schools when taught using digital tools and those taught with expository method?

Table 2: Mean and standard deviation of male and female students pretest and posttest achievement mean scores in soap production in secondary schools when taught using digital tools and those taught with expository method

Groups	N	Pretest		Posttest		Mean Gain
		Mean	SD	Mean	SD	
Experimental						
Male	23	5.70	1.15	17.39	2.02	11.69
Female	27	8.19	1.00	18.96	1.76	10.77
Control						
Male	18	5.22	1.26	14.11	2.63	8.89
Female	32	8.34	1.04	16.50	2.30	8.16

Results in Table 2 show the mean difference (posttest-pretest mean scores) for male students in experimental and control groups to be 11.69 and 8.89 respectively, while those of the female counterparts are 10.77 and 8.16 respectively. This result indicates that male students performed better than female students when taught soap production in the two groups. A comparison of the mean difference of students in the two groups setting by gender shows that the male proved superior to their female counterparts in answer to research question 2.

Table 2 also showed that the standard deviation of male and female students taught soap production using digital tools is 2.02 and 1.76 respectively while the standard deviation of male and female students taught soap production using expository method is 2.63 and 2.30 respectively. This indicates that the scattering of scores from the mean scores of male students taught using digital tools were higher that of their female counterparts while the scattering of scores from the mean scores of male students taught using expository method higher that of their female counterparts.

Hypotheses

Hypothesis one: There is no significant difference between Chemistry students' academic achievement in soap production in secondary schools when taught using digital tools and those taught with expository method.

Table 3: Summary t-test Analysis of Academic Performance Mean Scores of Experimental and Control Groups

Source of Variance	N	Mean	SD	Df	t-value	p-value	Decision
Experimental	50	18.24	2.03	98	5.49	0.02	Significant
Control	50	15.64	2.66				

*significant at $p < .05$

In Table 3, the p- value is 0.02 which is less than 0.05 level of significance at 98 degree of freedom. This indicates that at $p < 0.05$, the difference in using digital tools or not on students' achievement is statistically significant. That is, there is a significant difference between Chemistry students' academic achievement in the teaching of Soap production in secondary schools using digital tools and with expository method. Hence, the null hypothesis was rejected. This means teaching Soap production in secondary schools using digital tools is effective in enhancing student's achievement.

Hypothesis Two

There is no significance difference between male and female Chemistry students' academic achievement in soap production in secondary schools when taught using digital tools and those taught with expository method.

Table 4: Summary of t-test Analysis of Academic Performance Mean Scores of Experimental and Control Groups

Source of Decision Variance	N	Mean	SD	Df	t-Value	p-value	
Male	41	15.95	2.81	98	3.21	0.15	Not Significant
Female	59	17.63	2.40				

*significant at $p < .05$

In Table 4 the p- value is 0.15 which is greater than 0.05 level of significance at 98 degree of freedom. This indicates that at $p < 0.05$, the difference in using digital tools or not on male and female students' achievement is not statistically significant. That is, there is no significance difference between male and female Chemistry students' academic achievement in the teaching of soap production in secondary schools using digital tools and with expository method. Hence, the null hypothesis was retained. This indicates that both male and female students had equal achievement.

Discussion

The results obtained from the study indicate that students taught using digital tools achieved higher scores than those taught with expository method. This can be attributed to the fact that computer as a digital tool provide students with the opportunity to develop and use higher-level thinking skills to solve problems that are relevant to their daily lives. It can also be argued that the use of digital tools enhanced students' achievement in soap production, therefore making them to obtain high scores. This is in line with studies by Wohlfart, Wagner & Wagner (2023) that digital tools have the potential to enhance learning outcomes and recommends teacher training and further education as well as future research to focus on developing and supporting opportunities for teachers to implement subject-specific digital tools to create a more dynamic and engaging learning experiences for students.

Findings of this study showed that there is a significant difference between Chemistry students' academic achievement in the teaching of Soap production in secondary schools using digital tools and with expository method. Hence, the null hypothesis was rejected. The findings of this study concur with that of Walan (2020) on embracing digital technology in science classrooms which found out that digital technology improved teaching, motivated the students and made learning easier.

Findings also show that there was no significant difference between male and female Chemistry students' academic achievement in the teaching of soap production in secondary schools using digital tools and those taught with expository method. This is likely due to the keen interest observed in both gender when it comes to learning with digital tools. The findings are in line with Ajayi & Ogbeba (2017) and Udu (2018) who observed that the interaction between methodology and gender has no significant impact on students' achievement in science. This is also in line with Ekon & Amanso (2015) who demonstrated that there is no significant difference in the achievement of male and female students in science. This finding is in contrast with Eden & Mbuk (2019) and Etiubon (2011) who demonstrated that female students performed better than male showing that there is a significant difference in the achievement of male and female students in science.

Conclusion

Findings in this study indicate that:

- (i) The use digital tools in teaching of Soap production in secondary schools leads to higher student achievement in Chemistry teaching of soap production compared to experimental teaching methods. Digital tools can be used to address the challenge of poor academic performance.
- (ii) This study also showed that the use of digital tool reduces gender parity in Chemistry achievement. Digital tools could therefore be used to address the challenges of gender parity towards learning Chemistry concepts. This study revealed that gender does not affect achievement in Chemistry when digital tools are used.

Recommendations

The following recommendations are made based on the result of the study;

1. Chemistry teachers should be encouraged to adopt the use of digital tools such as computers, phones, video and audio devices in the teaching and learning of science concepts.
2. Government should organize conferences, seminars and workshops chemistry teachers to acquaint them with latest digital tools to improve the teaching of soap production and other concepts in Chemistry.

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