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Impact of Teaching with an Interactive Whiteboard on Science Students' Academic Achievement in Secondary School Chemistry in Rivers State

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Abstract: *There are many obstacles that may impede effective teaching and lead to students' low academic achievements in chemistry, despite the fact that a teacher's familiarity with the subject matter and presentation skills are crucial to the success of a Chemistry classroom. The unavailability of efficient instructional methods and resources is an example of the obstacles. So, this study set out to see how well chemistry students in Rivers State's secondary schools would achieve if they were taught using an interactive whiteboard (IW). The study was quasi-experimental, in that it included both pre- and post-testing.The study's sample size was 100 students from four complete SS2 classes randomly arranged into two groups. Both groups were taught chemistry, however the experimental group was taught on an interactive whiteboard (IW) while the control group was taught on a non-interactive magnetic marker whiteboard (MW). A valid and reliable Chemistry Achievement Test (CAT) was developed using the K-R 20 to establish its internal consistency reliability of 0.95. Hypotheses were tested using analysis of covariance (ANCOVA) at the (P=0.05) level, and the mean and standard deviation were utilised to provide answers to the study questions. Students who were taught chemistry using IW-based instructional aids outperformed those who were taught with MMW. Location made a big difference in how well pupils did on the CAT, with students in urban location scoring higher than rural students. This study led the author to suggest that public schools in both rural and urban regions should be outfitted with IW-based instructional facilities to improve chemistry teaching and learning.*

Keywords: *Interactive whiteboard, magnetic whiteboard, chemistry, locality, academic achievement.*

1. INTRODUCTION

1.1 Background of the study

Chemistry is the discipline of science that investigates the nature of matter and the processes that regulate its transformations. It is a core scientific curriculum component at the secondary school level. In the Nigerian educational system, the choice of teaching approach for Chemistry is left up to the discretion of the instructor based on some factors such as the pupils, and the available resources, just as it is for all other disciplines. Since chemistry has been shown to be less appealing to students of all ages (Cheung, 2009), many chemistry instructors have focused their efforts on discovering new and improved means of delivering high-quality chemistry education. There has been a lot of focus on other types of teaching materials, but there is still a lot of unexplored territory when it comes to using interactive whiteboards (IW) to teach chemistry and other scientific courses in secondary schools in Nigeria.

Even the world's poorest regions are seeing digital progress. This generation relies heavily on technology for not just communication but also the facilitation of a broad range of human activities. The incorporation of computers into educational settings is becoming more common.

Video games, electronic periodicals, virtual worlds, and multimedia presentations are only few examples of digital media where this phenomenon is particularly pronounced. Thanks to the advent of multimedia, lessons may now be presented with greater vigour and excitement. These days, most schools use an interactive whiteboard (IW) in lieu of a traditional blackboard or whiteboard. The classic whiteboard with marker technology has been superseded with the more expensive interactive whiteboards (IW).

Smart boards, also known as interactive whiteboards (IW), have found their way into classrooms in recent years (Smith, Higgins, Wall, & Miller, 2005). IWs are "devices that connect a computer, a multimedia projector, and a touch screen electronic whiteboard," as described by Ajelabi (2015). The user may manipulate the projected picture using the computer's software via this setup. The IW ouch may be either freestanding touch-screens computers, or they can be attached to other computers and utilised as touch pads. At the centre of the IW is a touch-screen smart board, on which students may do experiments, find solutions to issues, write, and erase using a number of different software applications (Klammer, 2011). Depending on the software installed, these whiteboards may be utilised as electronic microscopes, multimedia goods, films, data tables, CD ROMs, or even the internet (Miller, Glower, & Averis, 2005).

Botswana's government and non-governmental organisations have worked together on many projects on educational technology improvement initiatives in schools (Tau, 2008). The SMART Technologies Pilot Project was one such initiative; its goal was to equip a subset of schools in the country with cutting-edge technology in the form of interactive SMART boards for use in the classroom (Tsayang, Batane, & Majuta, 2020). The SMART board was first used in Nigerian classrooms in 2009 (Ukwueze &Onyia-Amaechi, 2014). Dual touch interactive smart boards are a feature of modern smart board technology. The smart board's two touch points allow for simultaneous use from each side. The Smart Board is part of a system that also includes a computer, a projector, and interactive software (also referred to as a "Smart notebook" or "collaborative software"), which together form the "Smart" element of the system. The parts are linked together using radio waves, USB, and specialised wires. Images are projected onto the Smart board through a computer and attached projector. The smart board is becoming more popular among educators. In a similar vein, Ukwueze and Onyia-Amaechi (2014) reaffirmed that using a Smart board may improve the quality of instruction delivery and boost clarity and degree of information in a lesson.

Smart boards are one of the most widely used forms of instructional technology nowadays, as stated by De Vita, Verschaffel, and Elen (2018). In the late 1990s (Beeland, 2002), the first smart boards appeared in classrooms. Since then, their usage has spread rapidly throughout the globe, with the UK swiftly becoming one of the most advanced markets for this technology. According to Akar (2020), the United Kingdom invested £50 million between 2003 and 2005 to promote the use of smart boards in classrooms. According to a study conducted in 2010 (Lai, 2010), smart boards were in use in 100% of primary schools and 98% of secondary schools in the United Kingdom by 2007. According to a 2013 study (Hennessy & London, 2013) referenced by Aflalo, Zana, and Huri (2018), smart boards are utilised in around 70% of classrooms in the Netherlands, Denmark, and Australia, 50% of classrooms in the United States, Canada, and Spain, and 20%-30% elsewhere.

1.2 Statement of the Problem

While a teacher's familiarity with the subject matter and skill in communicating it to pupils are crucial, several factors might get in the way of an instructor's capacity to effectively convey chemical concepts to their students. Some of the obstacles include a lack of effective teaching strategies and materials. In order for chemistry students to acquire the material covered in class, it is necessary to seek for new or improved teaching strategies and materials. Those who have experimented with the interactive whiteboard (IW) paradigm in education have had mixed results; however, to the author's knowledge, no study has been conducted utilising the IW to teach chemistry to secondary school students in Rivers State. This study set out to answer the question, "How does using an IW to teach chemistry affect the academic performance of science students in senior secondary schools in Rivers State?"

1.3 Purpose of Study

The goal of this research is to find out how much of an effect switching to utilising an IW instead of an MMW has on chemistry test scores for students in secondary school in Rivers State.

1.4 Research Questions

Two research questions (RQ) guided the study:

RQ1: What are the mean achievements scores of students taught chemistry with interactive whiteboard and those taught with magnetic whiteboard?

RQ2: What are the mean achievement scores of rural and urban students taught chemistry with IW?

1.5 Research Hypothesis

Three research null hypotheses (Ho) guided the study:

Ho_1: Teaching chemistry using an interactive whiteboard rather than a magnetic whiteboard does not seem to improve students' grades .

Ho_2: In chemistry, for example, there is no discernible gap in the average performance of students in rural and urban areas.

1.6 Significance of the study

The findings of this research will be useful to those with a vested interest in education since it will demonstrate to them the need of investing in the latest and greatest educational technology to enhance the teaching and learning process.

2.0 LITERATURE REVIEW

Ifeakor, Akujieze, and Erutujiro (2020) conducted a study in Onitsha North L.G.A., Anambra State, to see how using an IW-based teaching strategy affected students' maths performance. The findings showed that the IW based instructional model outperformed the lecture technique in raising students' maths scores.

The effects of SMART boards on Botswanan pupils' education were studied by Tsayang, Batane, and Majuta (2020). According to the results, SMART technologies have the potential to revolutionise teaching and learning in Botswana as the country strives to give its children access to an education on par with the best in the world and reinvents itself as a modern economy.

Dhindsa and Emran (2006) studied the effects of using IW in the classroom by comparing the test scores of students before and after they were exposed to six different organic chemistry lectures. The authors observed that the IW group made statistically significant increases compared to the control group.

After taking an optional 13-week course in Educational Technology, Nigerian undergraduates were studied by Ajelabi (2015) to determine the impact of using an IW on their performance in the classroom. Results demonstrated no statistically significant difference in learning outcomes between students in the experimental group, who received instruction using the traditional lecture approach mixed with the IW, and students in the control group, who received the identical instruction using the conventional lecture method alone. Although there has been no discernible improvement in students' performance as a result of using IW, it has been seen that students are more involved, dedicated, attentive, and interactive with both their classmates and the instructor.

Researchers Turel and Johnson (2012) looked at how incorporating the IW into mathematics classes would affect students' attitudes and performance, and they found that it improved both. Students performed higher on the accomplishment exam while using the smart board as opposed to the conventional technique, according to research by Ukwueze and Onyia-Amaechi (2014). Uzun(2014) said that students have a hard time keeping up with lectures and reading materials while using the IW, but that students' curiosity is piqued as a result, making for more engrossing classes and topics across the board.

The impact of IW on academic performance was investigated in a two-year longitudinal research by Higgins, Beauchamp, and Miller (2007). Based on their research, they concluded that standardised exam results did not vary much between institutions utilising IW and those that did not. Lewin, Somekh, and Steadman (2008) discovered that pupils aged 7-11 made statistically significant improvements in reading, maths, and science. This was because the IW had been used for such a long period in the classroom.

The use of smart boards improves the learning environment by introducing visual and auditory components, making learning materials more concrete (Batd', 2017; Demir, ztürk, &Dökme, 2011), making lessons and learning enjoyable, and increasing students' interest, motivation, participation, and concentration in the lesson and also allow interaction between teacher and student (Ceren & Ergul, 2017; Batdı, 2017; Davidovitch & Yavich, 2017), boost the participation of students and offer permanent learning (Paragina, Paragina & Jipa, 2010), grant more learning content and foster students' adeptness to use technology (MannyIkan, Dagan, Tikochinski & Zorman, 2011).

3.0 METHODOLOGY

3.1 Research design

The research used a quasi-experimental approach, including a control group and an intervention group, with pre- and post-testing. In other words, pre- and post-study measurements of the dependent variable were taken from the individuals. The effects of using an interactive whiteboard were studied to see how they impact on students' performance in chemistry classes. Both groups were taught in a lecture style, however the experimental group used an interactive whiteboard while the control group used a magnetic whiteboard..

3.2 Sample and Sampling procedure

Sixty pupils from urban areas and forty from rural areas made up the sample for this research of S.S.2 students in the sciences. The sample was drawn from four different schools, two suburban and two urban, all of which had whole classes available. Both the test and control classes were selected at random. There were more pupils in each class than were needed for the analysis. However, the sample only included students who were present regularly.

3.3 Instruments

Chemistry experts from the Ignatius Ajuru University of Educaton (IAUE) in Port Harcourt, Rivers State, reviewed and approved the Chemistry Achievement Test (CAT) used to collect the data. The reliability of the instrument was 0.95 based on internal consistency using the Kuder-Richardson formula 20.

3.4 Data Collection

Before beginning treatment, a pre-test was given to the subjects to guarantee homogeneity of the subjects after permission was received from the authorities of the chosen schools and the participating pupils were told about the necessity for them to participate in the research. Teachers (research assistants) at the selected schools administered and scored the tests themselves using the researcher-created rubrics. The researcher read each script and tallied the data manually, line by line. Each person's performance on the instrument was recorded next to their name. Five weeks later, after receiving instruction in three chemically-focused areas, students took the same exam again (posttest) to gauge their progress.

3.5 Method of Data Analysis

Data from both groups were recorded and analysed in light of the specified study objectives and hypotheses. Analysis of covariance (ANCOVA), standard deviation, and mean were used to examine the data. The significance (probability) threshold at which all hypotheses were evaluated was set at p 0.05. The hypothesis is considered significant if its probability (p) is less than.05 and insignificant otherwise.

4.0 PRESENTATION OF RESULTS

Table 1: Achievement scores of students taught with IW and MW.

Groups		Pre-test		Post-test		Mean Gain
	Number	Mean	S.D	Mean	S.D	
Experimental	50	41.00	13.57	62.68	20.08	21.68
Control	50	35.76	16.69	45.36	21.29	9.60

Table 1 shows that compared to students taught chemistry using a more conventional manner using a MW, those taught using an IW had a significantly higher mean post-test score (62.68, SD = 20.08). Students who were taught chemistry using IW had significantly higher mean gain scores (21.68) than their non-IW counterparts (9.60).

Table 2: Achievement scores of rural and urban students in chemistry

Groups		Pretest		Posttest		Mean Gain
	Number	Mean	S.D	Mean	S.D	
Rural	23	35.36	8.09	49.41	10.50	14.05
Urban	27	36.00	8.96	62.18	9.97	26.18

Results shown in table 2 demonstrate that urban science students obtained a higher posttest score than their rural counterparts, with a mean gain score of 26.18 compared to 14.05 for rural students.

Table 3: Ancova test of difference in mean achievement of scores of students taught using IW and taught using MW.

Dependent Variable: posttest

Source	Type III Sum of Square	Df	Mean Square	F	Sig.
Corrected Model	4161.985[a]	2	2080.992	3.813	.025
Intercept	16986.253	1	16986.253	31.125	.000
Pretest	229.567	1	229.567	.421	.518
Interactive WB	4161.944	1	4161.944	7.626	.007
Error	52937.005	97	545.742		
Total	417219.000	100			
Corrected Total	57098.990	99			

a R Squared = .073 (Adjusted R Squared = .054)

Table 3 displays the probability associated with the calculated value of F (7.626) for the effect of treatment on students' performance in chemistry as.007. The probability of.007 is less than the.05

threshold required to reject the null hypothesis, hence the null hypothesis is rejected. Therefore, there is a statistically significant difference between the mean accomplishment scores of students taught chemistry using IW and those taught using the conventional teaching strategy utilising MW.

Table 4: Ancova test of the effect of location on chemistry achievement scores

Dependent Variable: posttest

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	2200.510[a]	2	1100.255	10.760	.000
Intercept	5938.382	1	5938.382	58.076	.000
Pretest	191.615	1	191.615	1.874	.178
Locality	1959.827	1	1959.827	19.167	.000
Error	4805.810	47	102.251		
Total	166958.000	50			
Corrected Total	7006.320	49			

a R Squared = .316 (Adjusted R Squared = .285)

The effect of students' home cities on their chemistry grades is not statistically significant at the.000 level, as shown in Table 4. The probability value of.000 was less than the.05 cutoff for statistical significance, hence the null hypothesis was rejected. As a consequence, students' chemistry performance is highly influenced by their geographical location.

5.0 DISCUSSION, CONCLUSION AND RECOMMENDATIONS

5.1 Discussion

Student performance on CAT was much higher for those who had been taught using an IW rather than an MW, according to the data. Ifeakor, Akujieze, and Erutujiro (2020) discovered that an IW based instructional model in teaching was more successful than the lecture technique in boosting students' mathematics results, therefore this present results are congruent with their findings. This result is also similar with the results of Dhindsa & Emran (2006) on a six-lesson study comparing students in college organic chemistry classes taught with and without IW which indicated statistically significant gains for the IW group. The lecture method requires students to blindly follow the teacher's lead, while the IW based model encourages students to think critically and creatively. Unlike MW, which only allows students to study through the lecture method, IW is a technological all-in-one teaching-learning board that offers the students diverse audio-visual learning opportunities, helps them to have control over their learning and collaborate with others, and, as a result, raises students' curiosity, motivation, and achievement. Children's academic development is accelerated by IW since it makes learning more interesting and entertaining.

The research also found that where the student lived had a substantial impact on their scholastic performance in chemistry. Despite the fact that rural students in the experimental group were taught using IW, it was found that urban science students had a better mean score on the CAT. Most rural students probably haven't seen (or been exposed to the usage of) IW, which might explain why they do worse than their urban counterparts in science. The experiences and prospects available to a person will vary depending on where he lives. Students in metropolitan areas are more likely to have positive experiences with the integration of technology into the classroom. This is because children in urban regions have access to these tools more readily than their rural counterparts do, whether at school or elsewhere in town, and because of the widespread availability of energy in metropolitan areas. In his investigations, Raju (2013) also discovered that students' home environments had a substantial effect on their performance in seventh-grade social studies.

5.2 Conclusion

The results of the research support the idea that incorporating smart boards into the classroom might improve students' motivation, engagement, and performance in a science subjets, such as chemistry. Once again, a student's academic progress might be helped or hindered by where their school is located, since it will provide them with varied chances and experiences. It is possible that most students in rural schools do not see or utilise IW, which contributes to the higher success of urban science students over the rural ones in chemistry.

5.3 Recommendations

Based on the findings of the study, the following recommendations were made by the researcher:

1. To improve the quality of chemistry and other scientific education in public schools throughout the country, the federal government should fund the installation of interactive whiteboards (IWs) at both suburban and inner-city schools.
2. It is recommended that chemistry be taught using IW at all educational levels.
3. Workshops and seminars hosted by organisations like the Chemical Society of Nigeria and the Science Teachers' Association of Nigeria would be beneficial for chemistry teachers to learn more about the IW usage in teaching.

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