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Renewable Resources in Teaching Chemistry Practical and Students' Learning Outcome in Secondary Schools

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ABSTRACT

The study investigated on renewable resources in teaching chemistry practical and students' learning outcome in secondary schools in Mkpat Enin Local Government Area. A quasi-experimental research design was adopted for the study. The population of the study consisted of 1844 Senior Secondary Two (SS2) students in 16 public secondary schools in the study area. A sample size of 94 chemistry students selected from two secondary schools were used for the study. In each of the selected schools, one intact class of SS2 students was used for the study. The instrument for data collection was Chemistry Practical Test (CPT) with reliability coefficient of 0.86 obtained using Kuder-Richardson Formula-20. Data were analyzed using mean, standard deviation and Analysis of Covariance (ANCOVA). Findings showed that there was a significant difference in students' learning outcome when taught acids and bases titration using renewable resources and those without in favour of renewable resources. Gender was not a significant determinant of students' practical learning outcome when exposed to renewable resources. Hence, the study concludes that the use of renewable resources as a replacement for toxic chemicals for teaching of practical Chemistry is more effective in facilitating and enhancing students learning outcome. The study recommends that Chemistry teachers use renewable resources in practical lessons, as they make learning more relatable, provide firsthand knowledge of local materials in the environment, replace toxic chemicals, and ultimately improve students' learning outcomes in Chemistry.

Keywords: Renewable Resources, Chemistry Practical, Students' Learning Outcome

INTRODUCTION

In recent years, there has been a significant focus on renewable resources and renewable energy sources, highlighting the global shift towards sustainable energy. Scientists have been actively studying renewable resources to raise awareness of their abundance and importance. Renewable resources replenish themselves over time, making them crucial for a sustainable environment. Common renewable resource include; water, plants, food and non-food resources, solar, geothermal and wind power among others (Park & Allaby, 2017). Historically, renewable resources like firewood, latex, guano, charcoal, wood ash, plant colors as indigo, and whale products have been crucial for human needs (Radkau, 2008). Renewable resources are a part of Earth's natural environment and the largest components of its ecosphere. Sustainable harvesting of these resources can help reduce pollution and habitat destruction, contributing to a healthier ecosystem.

Despite all the initiatives undertaken to raise awareness about the need for conserving natural resources due to their limited availability, environmental degradation persists. One of the goals of sustainable development goals (SDG) is shifting energy consumption from fossil fuels to renewable resources to reduce environmental damage and prevent global warming (Hoque, Yasin & Sopian, 2022). This global effect has made it necessary to instill awareness among citizens at an early age, even in secondary schools on possible utilization of renewable resources as they will replenish to replace the portion depleted by usage and consumption (Hoque, Yasin & Sopian, 2022). Also, students understanding of the scale of environmental issues, adopting energy-saving habits, and fostering ecological lifestyles are vital for a sustainable future (Hatziargyriou, Asano, Iravani, & Chris, 2007).

Chemistry plays a crucial role in the development and optimization of renewable resources, as it provides the fundamental knowledge and techniques needed to harness, improve, and sustain energy and material sources that are renewable and eco-friendly. Chemistry is a science subject that is taught theoretically and practically to enhance students understanding of various concepts. Learning through chemistry practicals is regarded as learning by hands-on activities. Hands-on can be captured as learning by experience through students' interaction with learning tools and aids that will enhance learning process (Afyusisye, & Gakuba, 2022). Students' experience in the chemistry laboratory when doing experiments gives them a more realistic experience of the content. This way of learning provides a conducive learning environment for students. Tesfamariam, Lykknes, and Kvittingen (2014) highlighted that practical work leads to better learning of chemistry concepts. Practical work as hands-on activities allow students to engage in kinesthetic learning. Kinesthetic learning is the learning style in which information is processed through movement and touch (Navaneedhan, 2015).

Incorporating renewable resources into the teaching of chemistry practicals can greatly enhance students' understanding and engagement by making abstract concepts more tangible and relevant to their environment. Odunlami, Folami, Oso, and Omoboh, (2020) opined that renewable resources like plants materials are good source of chemical substances. Chemical substances such as Potash are obtained from some plant materials and have also been studied by several researchers (Adewuyi, Obi-Egbedi & Babayemi, 2017). Previous studies have also been made on the extracts of alkalis from wood ashes, indicators from plant flowers to mention just a few (Afrane, 2015). These materials gotten from plant extracts are source of replacement to toxic materials used in chemistry laboratory practical which serves as alternative resources to teaching. Based on empirical evidence, Afyusisye and Gakuba, (2022) found that there was a significant difference in performance between students who studied chemistry through practical and those who studied chemistry without practical. Mwangi (2016); Olubu (2015) found that chemistry practical has positive effect on the academic performance of students. Musa, Acheme, Affiku, Luka and Tukson (2022); Umanah and Sunday (2022) found that there is no significant difference in performance in chemistry of girls and boys exposed to chemistry practical’s and those not exposed. Learning outcome in chemistry is no gender exception it cut across both male and female but it is very important to find out the level of failure between male and female so as to proffer adequate solution to it. Hence, also sought to further investigate the influence of gender on students’ learning outcome when taught the concept of acid-bases titration in chemistry using renewable resources.

Despite the availability of these renewable resources in our immediate environment, teachers in secondary schools fail to realize the importance of this resources in teaching of chemistry practical. Teachers rely so much on industrial reagent which are more toxic to both teachers, students and the environment (Okam & Zakari, 2017). Most of these reagents are quite expensive to acquire and also unavailability of well-equipped laboratory among others factors are also major issues in Nigerian secondary schools. These factors in one way or another has contributed to students’ low experience or no experience at all in chemistry practical resulting in poor performances in external examinations such as WAEC (Okeke, 2019; Tsobaza & Njoku, 2021). Therefore, there is a need for teachers to use renewable resources to teach chemistry concepts as it is more affordable, students friendly, environmentally sustainable and will help bring students from what they know in their immediate environment into chemistry teaching and practical as practical are core to the mastery of chemistry knowledge. Hence, teaching and learning chemistry at any level of education should involve practical work

Statement of the Problem

Teachers in Nigerian secondary schools often fail to realize the importance of renewable resources in teaching chemistry practicals. They rely heavily on toxic industrial reagents, which are expensive to acquire as well as unavailability of functional laboratory in some schools. These among others factors has led to students' low experience in chemistry practicals, resulting in poor performance in external examinations. Therefore, there is a need for teachers to use renewable resources in chemistry teaching, as they are more affordable, student-friendly, and environmentally sustainable. Hence, this study sought to investigate the effect of renewable resources in teaching chemistry practical and students' learning outcome in secondary schools in Mkpat Enin Local Government Area.

Hypotheses

The following null hypotheses will test at 0.05 level of significance:

1. There is no significant difference in students' learning outcome when taught acids and bases titration using renewable resources and those taught without.
2. There is no significant difference in the learning outcome of male and female students taught acids and bases titration using renewable resources.

Method

The study employed a quasi-experimental design, specifically a non-equivalent, pre-test, posttest and control group design. The population of the study consisted of 1840 Senior Secondary School Two (SSS2) students in the sixteen public Secondary Schools in Mkpat Enin Local Government Area. A sample size of 94 SS2 chemistry students was used for the study. Simple random sampling technique was used in selecting two co-educational secondary schools and in each of the selected schools, intact class of SS2 Chemistry students was used for the study. The instrument for data collection was the Chemistry Practical Test (CPT). Chemistry Practical Test is 20 items with 4 multiple choice options developed by the researcher. The reliability of the instruments was determined through trial testing using a sample of 20 SS2 chemistry students with reliability coefficient of 0.86 obtained using Kuder-Richardson Formula-20. The data collected were analyzed using mean, standard deviation and Analysis of Covariance (ANCOVA).

Results

Hypothesis One: There is no significant difference in students' learning outcome when taught acids and bases titration using renewable resources and those taught without renewable resources.

Table 1: ANCOVA result on the difference in learning outcome of students based on learning aids and those without (N = 94)

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	186.546[a]	2	93.273	12.477	.000
Intercept	1338.465	1	1338.465	179.038	.000
Pretest	10.892	1	10.892	1.457	.231
Learning_Aids	176.346	1	176.346	23.589	.000
Error	680.305	91	7.476		
Total	19912.000	94			
Corrected Total	866.851	93			

a. R Squared = .215 (Adjusted R Squared = .198)

ANCOVA test result in Table 3 reveals that there is a significant difference in students' learning outcome when taught acids and bases titration using renewable resources and those taught without renewable resources {($F_{1, 93}$) = 23.589, $P < 0.05$.} for teaching aids. Since the p-valve for teaching aids is lesser than the level of significance, the null hypothesis one of this study is therefore rejected.

Hypothesis Two: There is no significant difference in the learning outcome of male and female students taught acids and bases titration using renewable resources and those taught without renewable resources.

Table 2: ANCOVA result on the mean performance scores of male and female students based on learning aids and those without (N =94)

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	14.160[a]	2	7.080	.756	.473
Intercept	1341.546	1	1341.546	143.171	.000

Pretest	9.648	1	9.648	1.030	.313
Gender	3.960	1	3.960	.423	.517
Error	852.691	91	9.370		
Total	19912.000	94			
Corrected Total	866.851	93			

a. R Squared = .016 (Adjusted R Squared = -.005)

ANCOVA test result in Table 4 reveals that there is no significant difference in the learning outcome of male and female students taught acids and bases titration using renewable resources and those taught without renewable resources {($F_{1, 93}$) = .423, P> 0.05.} for gender. Since the p-valve for gender is greater than the level of significance, the null hypothesis two of this study is therefore rejected.

Discussion of Findings

The study found that students who were taught acids and bases titration using renewable resources had significantly better learning outcomes. This is due to the first-hand information and experience gained during practical work. Also, local resources such as coconut husk, plantain peel, and cocoa pod husk vinegar used in place of industrial reagents make learning more relatable by connecting academic content with students' everyday experiences, making abstract concepts easier to understand. This aligns with previous research, Afyusisye and Gakuba (2022); Mwangi (2016) which found that practical learning positively impacts academic performance. However, the study also found no significant difference in learning outcomes for male and female students. This suggest that incorporating renewable resources in chemistry education can lead to better academic performance and better learning outcomes for all students regardless of gender. This aligns with the study of Musa, Acheme, Affiku, Luka and Tukson (2022); Umanah and Sunday (2022) which found no significant difference among male and female students in chemistry.

Conclusion

It is evident from the findings of this study that the use of renewable resources as a replacement for toxic chemicals for teaching of practical Chemistry is more effective in facilitating and enhancing students learning outcome. Also, it was therefore concluded that students' learning outcome when exposed to renewable resources in chemistry in secondary schools is no gender bias. Hence, there is no need for separation of male and female students when exposed to renewable resources during practical chemistry.

Recommendations

1. Chemistry teachers use renewable resources in practical lessons, as they make learning more relatable, provide firsthand knowledge of local materials in the environment, replace toxic chemicals, and ultimately improve students' learning outcomes in Chemistry.
2. Chemistry teachers should improvise materials for Chemistry practical teaching/learning activities where materials are not available as it enhances the overall learning outcome of students.
3. Conferences, seminars, and workshops should be organized through Ministry of Education, school administrators and professional bodies such as Science Teachers Association of Nigeria (STAN) to sensitize Chemistry teachers with a view to improving their skills and experiences on the improvisation of materials for chemistry practical.

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