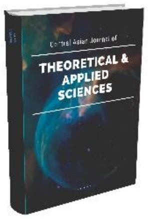

CENTRAL ASIAN JOURNAL OF THEORETICAL AND APPLIED SCIENCES

Volume: 03 Issue: 07 | Jul 2022 ISSN: 2660-5317
https://cajotas.centralasianstudies.org

Imperative Effectiveness of Locally-Made Acids and Bases on Senior Secondary Chemistry Students' Academic Performance in Rivers State

Etokeren. I. S.
Department of Science Education, Faculty of Education Rivers State University, Port Harcourt, Rivers State, Nigeria
inibeheetokeren@gmail.com

Chinda. W.
Department of Chemistry, Faculty of Natural and Applied Sciences Ignatius Ajuru University of Education, P.M.B. 5047, Rumuolumeni, Port Harcourt, Rivers State, Nigeria
wororolly@gmail.com

Received 25th May 2022, Accepted 14th Jun 2022, online 15th July 2022

Abstract: *This study investigated the effectiveness of locally-made acids and bases on Senior Secondary Students' academic performance in Rivers State, Nigeria. A descriptive survey design was adopted and the population comprised all public and private Senior Secondary1 chemistry students. 97 students in intact classes of selected schools formed the sample of the study. The instrument was Chemistry Performance Test. The face and content validity of the instrument was ascertained by two Science Education lecturers and one expert in Measurement and Evaluation. The reliability coefficient was calculated using the test-retest method and the value was 0.76. Mean and standard deviation was used to answer the research questions while the hypotheses were tested at 0.05 level of significance using t-test. Findings showed that locally-made instructional materials are more effective than factory-made ones and as such could serve the same purpose in schools where the ready-made instructional materials are not insufficient or unavailable. There was a significant difference between chemistry students' academic performance on acids and bases when taught using locally-made and factory-made instructional materials. Students taught with locally-made instructional materials obtained higher performance test scores than those taught with factory-made solutions. No gender-related significant difference was found while students' performance differed significantly based on school type. It was recommended among others, that chemistry teachers should always improvise instructional materials whenever the materials are not available and government should organize training for teachers on how to improvise chemistry instructional materials.*

Keywords: *Imperative Effectiveness, Locally-made, Acids, Bases, Academic Performance, Rivers State.*

Introduction

Teaching and learning of science concepts at all levels require proper blending of appropriate instructional materials with different teaching methods to enhance students' proper understanding of concepts presented in the classroom and realize the instructional objectives. This is complementary to the goals of Nigeria's educational system which advocate the acquisition of appropriate skills for the physical, social and mental development of individuals for the overall development of the nation (Federal Government of Nigeria, FGN, 2014). Consequently, a student-centered approach to science teaching which is not only highly activity-based but also promotes critical thinking in students enabling them to relate an abstract concept to the observable components in the physical world for easy understanding of scientific concepts is recommended. The teaching and learning of science at all levels of education involves experimentation through careful observation, collection and analysis of data, formulating and testing of hypotheses or theories and drawing a valid conclusion. These scientific processes and activities are always carried out in the laboratory using equipment and apparatus that are usually factory-made, most of which are imported and are too expensive which either limits its availability or accounts for non-availability in many private and government-owned schools in Nigeria. Therefore, science teaching and learning cannot be effective without practical activities in the laboratory.

Ideally, science is the intellectual human effort to understand better the history of the natural world and how the natural world works with observable physical evidence as to the basis of that understanding. It is done through observation of natural phenomena or through experimentation that tries to simulate natural processes under controlled conditions. This is the systematic study of nature and behaviour of the material and physical universe based on observation, experiment and measurement and the formulation of laws to describe these facts in general terms (Okori & Omenka, 2011). However, considering the high cost of materials for science teaching in Nigeria, there have been reported cases of shortage and non-availability of science teaching materials in school laboratories across the country. Hence the need for improvisation to supplement the ready-made ones. In some cases, substitution or construction may be used in place of improvisation. Substitution implies the use of already made local material in place of a piece of equipment that is not available and may be applied in place of improvisation while construction involves making of a new instrument to serve in place of the unavailable original one, where substitution is not possible (Igiri & Effiong, 2015; Awolaju (2016).

Conceptualizing the term ‘’improvisation’’ from different viewpoints, scholars have offered definitions of the concept. According to Eriba (2011), improvisation is the act of constructing instructional materials from locally available materials that can adequately replace or function in place of the original material, which otherwise may be very expensive, in short supply, or unavailable, whereas Oyediran (2011) defines improvisation as the act of using materials or equipment obtained from the local environment or produced by the teacher, and with the assistance of local personnel, to enhance learning. From the above, improvisation of teaching materials, in simple terms can be defined as the teachers-oriented activity which involves the production of unavailable or inadequate instructional materials or equipment with the help of available materials to enhance the process of teaching and learning. It is the technique of originating a very new tool, instrument, materials, or device or modifying existing ones for serving a particular purpose. The production of improvised material can be made from available local materials by the teacher or students under the teachers’ guidance teacher or fabricated by artisans. Local materials are those resources found within the environment that are useful and effective if properly utilized by a resourceful teacher in the teaching-learning activities (Mberekpe, 2013; Olatoye, 2017).

Microscopes, herbariums, laboratory chemicals, laboratory glassware, Bunsen burners, and tripod stands are examples of traditional educational resources. However, in instances where these traditional teaching methods are unavailable or insufficient, they might be made available through the process of improvisation. Laboratory reagents, laboratory glassware, Bunsen burners, microscopes, herbariums, and tripod stands are a few examples of typical or standard teaching tools. If these traditional teaching aids aren't offered or are insufficient, local production utilising resources from the environment is an option.

Typical examples of the process of improvisation of materials chemistry teaching include using juices of unripe orange as acid, a solution of ash from wood as a base, a candle or stove as a burner, teaspoon for the spatula. Teachers normally prepare local–materials to promote the physical, social, emotional and cognitive growth of learners (Abdu-raheem, 2016; Otor, Ogbeda & Ityo, 2015). The materials are designed to encourage learners to be curious and to take initiative by exploring and interacting with other learners. In the absence of ready-made resources, a teacher improvises appropriate alternatives to, solve the problem. Normally, the production of the alternative resources is usually initiated by the teacher and constructed by either the teacher or the local artisans such as carpenters and blacksmiths.

The use of teacher-produced improvised instructional materials and exposure of students to resources available in their immediate environment for instruction at the secondary level brings students to the real world of activities and helps students gain scientific skills. Such skills are only realizable through a well-planned training programme on improvisation. Generally, the use of locally available materials for improvisation has been widely acknowledged to be safer, cheaper, cultural- sensitive and can lead to the discovery of new knowledge and students' talents. Improvisation demands adventure, creativity, curiosity and perseverance on the part of the teacher (Obikezie, Maxwell & Chikendu, 2021). Our environment is richly endowed with materials that can be employed in the school to make teaching real and lively. It is, therefore, important to improvise instructional materials since it provides learners with a cognitive bridge between abstraction and reality of knowledge, widen the scope of inquiry, develop in learners the necessary process and practical skill and provide materials in abundant quantities thereby enabling learners to work independently

Apart from serving as an alternative to inadequate or unavailable instructional materials, the use of improvised instructional materials has numerous relevance to science teaching and learning in particular and education as a whole. However, teachers must note that, though very useful in teaching and learning science, improvised instructional materials may be identical and not the same as the conventional or readymade ones, therefore, teachers should be skilful in handling and using them. Furthermore, improvisation mostly in areas where the already-made instructional materials are not available requires considerable development through imaginative planning and good knowledge.

The use of improvised materials in teaching, if effectively managed and appropriately utilized presents the students with a more authentic picture of the real object, than the teacher can ever describe or explain. This process makes learning real practical and provides a bridge between the world outside and outside the classroom and at the same time encourage students' participation in the learning process. Interestingly, the teacher can also use improvised materials to capture students' imagination and motivate them to learn, remember what is learnt and easily recall the information when required. Furthermore, it promotes active teacher-student and student-student interaction, enhances the collaboration of ideas makes students more active and assist teachers.

Allowing the students to be involved in the construction process for the instructional materials helps to clarify unfamiliar concepts and develop their potential for learning science (Obi & Obi, 2019; Ibe, Obikezie, Maxwell & Chikendu, 2021; Aina, 2013; Oyediran, 2010; Okori, & Omenka, 2011). Instructional materials serve as a channel through which messages, information, ideas, and knowledge are disseminated more easily. They can, therefore, be manipulated, seen, heard, felt or talked about. They facilitate activities and are anything or anybody the teacher turns to, for help in his learning process. The interactive nature of some of the materials makes the learner part of the learning process.

Students find it easy and joyful to learn with instructional materials. Instructional materials are used to supplement verbal explanation of concepts or any description so that the lesson could be real to the students. It provides connectivity between students' abstract and real-world activities and helps students gain scientific skills. From the above, it is evident that materials can be improvised by the teachers and even students under the direct guidance of the teacher in addition to the use of local craftsmen. Students learn when their thoughts and expectations interact with materials, ideas, and people. such interactions give learners meaningful developmental learning experiences (Udogu, & Enukora, 2017). The use of instructional material in teaching could extend the scope and power of instruction. It could also help to bridge the gap between the teacher and students in terms of understanding different concepts in the lesson, thereby making learning more immediate and more relevant. To make teacher education programmes more viable, there must be room for the adoption of new principles and procedures in instructional technology that are necessary for growth in learning. This calls for more concern with the improvisation of materials through local initiatives.

Improvising instructional materials from locally-made materials saves cost in addition to providing opportunities to students with limited access to ready-made science materials mostly those in rural areas. A well-planned environment is inviting and interesting and conveys a message. It encourages creative expression and fosters experimentation and sensitivity to tactile and visual experience. Creativity in the classroom environment communicates to children and teachers what is expected of them and what is happening in the classroom. Locally produced instructional materials give teacher/students the pride of using their talents, allows a teacher to reproduce his potential, in concrete form and increase teachers' knowledge of the subject matter. The widespread recognition of the importance of local materials in teaching will encourage teachers to produce instructional materials for use in the teaching-learning process (Ibe, 2021). Furthermore, it saves teachers' time, is simple to make and requires little explanation by the teacher for students' understanding of the concept. When effectively utilized by the teacher, locally made materials help to stimulate students' interest, reduce the number of verbal responses and provide experiences not easily secured in other ways.

The problems associated with the lack and inadequacy of instructional materials, mostly in sciences has triggered a lot of research in different fields of science in a bid to proffer solution. Such studies include the study of Ibe (2021) investigated the effect of improvised instructional materials on chemistry students' academic retention in secondary school in Awka Education Zone in Anambra State. The study adopted a quasi-experimental design and the sample comprised 192 SS1 chemistry students purposively selected from co-educational schools. Twenty-five (25) Chemistry retention tests (CRT) were validated by two experts in the Science Education Department and educational foundation with a reliability coefficient of 0.81 determined using Kudar Richardson 20 (KR-20). Mean and standard deviation was used to answer research questions while analysis of covariance (ANCOVA) was used to test the hypotheses at 0.05 level of significance. According to the study's findings, students who were taught chemistry using improvised teaching materials performed much better than those who were taught using conventional instructional materials. Additionally, the experimental group retained more information than the control group did. The retention of students in chemistry was unaffected by the relationship between gender and the kind of teaching materials. It was suggested that training in the use of improvised educational materials be given to teachers in the teaching profession. Based on the study's findings, it was concluded that using improvised instructional materials to teach chemistry helps students stay in the subject longer.

Udogu and Enukora, (2017) investigated the efficacy of locally improvised materials and home activities on student achievement and retention in chemistry in Onitsha North Local Government Area of Anambra State. The pre-test, post-test, non-equivalent, non-randomized control group design of a quasi-experimental study was employed. The Sample comprised 120 SSII chemistry students drawn from two (2) randomly selected schools. The findings of the study revealed that there is no significant difference in the academic achievement of students taught chemistry with locally improvised instructional materials and those taught chemistry with standard instructional materials. Further findings showed that there is no significant difference in knowledge retention of students taught chemistry with locally improvised instructional material and that taught chemistry with standard instructional material. The study also revealed that instructional materials improve students' science skills.

Omiko (2016) investigated the level of utilization of available instructional materials, teacher-made instructional materials and the obstacles faced by the chemistry teachers during improvisation of the teacher-made instructional materials in Ebonyi State secondary schools. A descriptive survey research design was adopted using 397 chemistry teachers as the sample. The instrument was AEIMQ validated by 3 experts from the Science Education Department, and one expert from Measurement and Evaluation with a reliability coefficient of 0.81 served as the instrument. The results showed that teachers are not utilising the instructional materials that are already available in their lessons effectively, that chemistry teachers are not putting enough effort into creating the instructional materials that are not already available, and that teachers encountered challenges like a lack of funding and skill for the creation of instructional materials.

Ibe, Obikezie, Maxwell and Chikendu (2021) investigated the effect of improvised instructional materials on chemistry students' academic retention in acids, bases and acid-base reactions in Awka Education Zone in Anambra State. The study adopted a quasi-experimental design using 192 SS1 chemistry students purposively selected from co-educational secondary schools as the sample. The sample comprised twenty-five (25) items Chemistry Retention Test (CRT) validated by two lecturers in Educational Foundations Department. The reliability coefficient of the instrument coefficient of 0.81 was established using Kudar Richardson 20 (KR-20). Mean and standard deviation was used to answer the research questions while analysis of covariance (ANCOVA) was used to test the hypotheses at 0.05 level of significance. According to the study's findings, students who were taught chemistry using improvised teaching materials performed much better than those who were taught using conventional instructional materials. Additionally, the experimental group retained more knowledge than the control group did. The retention of students in chemistry was unaffected by the relationship between gender and the kind of teaching materials.

Obi and Obi (2019) investigated the effects of improvised instructional materials on the academic achievement of SS1 chemistry students in Cross River State Nigeria. A descriptive survey study approach was used with a sample of 100 Calabar Municipality SS1 Chemistry students. According to the Pearson Product Moment Correlation Coefficient, the tool was the Chemistry Assessment Test, which had a reliability coefficient of 0.79. To respond to research questions, descriptive statistics were utilised, and an Analysis of Covariance was performed to test the hypotheses at the 0.05 level of significance. The study's findings showed that students who were taught acids, bases, and salts using improvised materials outperformed those who were taught using instructional materials that had been manufactured. In the study, there was no discernible gender influence on the use of improvised teaching materials.

Kira (2016) assessed the use of Improvised instructional materials in teaching physics lessons in Tanga region community secondary schools Korogwe District of Tanzania. The sample for the study consisted of eight teachers. According to the study's findings, instructors' expertise in developing and utilising local resources to conduct experiments in community secondary schools was enhanced and expanded by the use of improvised instructional materials to conduct practical lessons. Further, evidence revealed that improvised instructional materials increase teachers' creativity, subject and pedagogical content skills for teaching physics practical work. Iji, Ogbole & Uka (2014) examined the effect of improvised instructional materials on students' achievement in geometry at the upper basic education level in Markudi Metropolis, Benue State. The sample for the study consisted of 189 students, and the test used was the Geometry Achievement Test (GMT). According to the study, students who were given improvised educational materials did better than those who were given traditional lectures. Additionally, both male and female students in the experimental group outperformed those using the traditional lecture-style in terms of their geometry achievement.

Mboto, Ndem & Stephen (2011) investigated the effect of improvised materials on students' achievement and retention of the concepts of radioactivity using pre-test post-test non-equivalent control group design and 240 SS3 physics students as ample. The results of the study showed a significant difference in achievement between the experimental and control groups in favour of the experimental group. There was a significant difference in the mean academic performance between male and female students in favour of the male students as well as a significant difference in retention between the experimental and control groups in favour of the experimental group.

Mbah (2013) examined the use of instructional materials and educational performance of students in integrated science: A case study of unity schools in Jalingo, Taraba State, Nigeria. The design was an experimental design and 249 students in the junior section of Federal Science and Technical College Jalingo formed the sample. The study's findings showed a substantial difference between students taught using instructional resources and those taught without them in terms of mean test scores. Students' academic performance improved when they were taught using instructional materials, regardless of gender. There was no discernible difference in performance between male and female students who were taught using instructional materials, which further data suggested increased the quality of learning in the students.

Oladejo, Olosunde, Gbolagade,. Ojebisi & Olawole (2011) examined the effect of using instructional materials on the academic achievement of secondary school physics students in Oyo State, Nigeria. The design was quasi-experimental of pre-test post-test non-randomized control group and Physics Achievement Test (PAT) instrument. The study's findings showed a substantial difference in the academic performance of students who were taught using traditional education, those who were taught using improvised instruction, and those who were not. In the post-test, the students who had received improvised education received the greatest achievement score, followed by those who had received traditional instruction, while the control group received the lowest score.

Statement of the Problem

The usefulness of instructional materials in teaching science is numerous. Apart from arousing students' interest, it makes the concept look real and enhances proper understanding of concepts mostly when the concept is abstract. Teachers apart from students, also benefit from the use of instructional materials because it refines and broadens teachers' knowledge on designing and the use of such local materials during lesson delivery. Inevitably, teachers depend on instructional materials for effective lesson delivery mostly on sciences because of the abstract nature of science concepts, particularly chemistry. Unfortunately, instructional materials are either unavailable or inadequate in many schools possibly due to high cost, poor funding and poor maintenance culture. This constitutes a problem which adversely affects students' understanding leading to concept difficulty and poor performance in chemistry examinations. In attempting to provide a solution to this problem, the research compares teaching with improvised instructional materials and teaching without instructional materials, while no effort has been made to compare the effectiveness of standard instructional materials with the one improvised by the teacher using locally made materials. Against this backdrop and in an attempt to address this problem, the researcher carried out this study to examine the effectiveness of using locally made or improvised acids and bases (lungs) and or factory-made acids and bases.

Purpose of the Study

This research examined the comparative effectiveness of teaching the concepts of acids and bases using locally-made and factory-made instructional materials in teaching chemistry concepts in secondary schools in Rivers State. Specifically, the study tends to determine:

1. students' academic performance in acids and bases when taught with locally-made and factory-made instructional materials in Rivers State.
2. male and female students' academic performance in acids and bases when taught with locally-made instructional materials in Rivers State.
3. private and public school students' academic performance in acids and bases when taught with locally-made instructional materials in Rivers State

Research Questions

1. What is the academic performance of students in acids and bases when taught with locally-made and factory-made instructional materials in Rivers State?
2. What is the academic performance of male and female students in acids and bases when taught with locally-made instructional materials salts in Rivers State?
3. What is the academic performance of private and public school students in acids and bases when taught with locally-made instructional materials in Rivers State?

Hypotheses

HO_1. There is no significant difference between students' academic performance in acids and bases when taught with locally-made and factory-made instructional materials in Rivers State?

HO_2. There is no significant difference between male and female students' academic performance in acids and bases when taught with locally-made instructional materials used in teaching acids, bases and salts in Rivers State.

HO_3. There is no significant difference in private and public school students' performance when locally-made instructional materials are used in teaching acids, bases and salts in Rivers State

Significance of the Study

The findings of the study will be beneficial to teachers, students and curriculum planners. It will provide an alternative or better replacement to the standard instructional materials that are so expensive. Further, it will provide a solution to the problem of scarcity, non-availability and insufficiency of instructional materials since the raw materials are found abundant and are easily accessible within the environment at virtually no cost. Teachers can also engage students to construct these materials for chemistry instructions which help to develop problem-solving skills in students and make them more resourceful during lessons. The study will be beneficial to curriculum planners who would design functional curricula by taking into consideration students', and teachers' improvised instructional materials. Presentation of the results of this study in workshops and seminars will guide the choice of improvised instructional materials used in the teaching/learning process in chemistry and other subject areas.

Methodology

This research adopted a quasi-experimental design specifically, the pre-test post-test control group design. The population of the study comprised all Senior Secondary one (SS1) chemistry students in Rivers State Senior Secondary Schools. 97 SS1 chemistry students representing 54 females and 43 males in intact classes of selected schools were used as the sample. The instrument was Chemistry Performance Test

(BPT) developed by the researcher and validated by two Science Education lecturers and one Measurement and Evaluation lecturer with the reliability coefficient. The reliability coefficient of 0.84 for the instrument was determined using the test-retest method and Pearson Product Correlation Coefficient formula. Items in the instrument were selected from already standardized West African Senior School Certificate Examinations (WASSCE) past question papers. The students in each school were randomly assigned experimental and control groups taught with factory-made instructional materials as control group. Students in the experimental group received treatment with locally-made instructional materials and those in the control group were taught with factory-made instructional materials. The instrument was administered to the students as a pre-test before treatment and a post-test after treatment. Mean and standard deviation was used to answer research questions while the hypotheses were tested using t-test analysis at 0.05 level of significance. Data were subjected to the SPSS version 25 for analysis. The null hypotheses were accepted when the calculated value of t is less than the table or critical value and rejected when the calculated value of t is greater than the table or critical value.

Treatment

Experimental Procedure for preparing acids, bases and salts from local materials.

The students in the experimental group were divided into groups with four students in each group and the provided with the following materials required for the preparation of solutions of acids, bases and salts. Under proper guidance from the teacher, the students were asked to follow the stated procedures in preparing each of the solutions and test them with litmus paper

Acids

The following acids were prepared from local fruits: citric acid, lactic acid and ascorbic acid.

(1) Preparation of acid from lime or orange fruits

Materials: 10 lime juice, beaker, funnel, cloth or wool

(a) Citric Acid

Materials: 10 lime juice or orange fruits, beaker, funnel, cloth or wool

Procedure

1. Wash the fruits with clean water
2. Cut the fruit into two and squeeze the juice into the beaker
3. Filter extracted juice using a clean cloth and funnel

Keep the extracted liquid juice is the citric acid in the reagent bottle

(b) Lactic Acid

Material: Milk

Procedure

Open a tin of milk and leave it overnight. The milk would be covered with a liquid content in the form of lactic acid

(c) Ascorbic Acid

Materials

1. 10 big tomatoes

2. Beaker
3. Cloth or cotton wool
4. Funnel

Procedure

1. Wash fruits with clean water
2. Cut tomatoes into two squeeze out fruit extract into the beaker.
3. Filter extracted juice using cotton wool or cloth
4. Filtered liquid content ascorbic acid that could be used in teaching acid and bases

Preparation of Base from local materials

The following bases were prepared from local materials: potassium hydroxide, calcium hydroxide

(a) Potassium Hydroxide

Materials: Dry cassava, dry plantain peels, clean cloth, beaker, water and stirrer.

Procedure

Burn any of the above peels the dry planarian peel or cassava pee cash

1. Put ash into the beaker
2. Stir the mixture very well
3. Filter mixture using cloth or cotton wool through the funnel
4. The filtered liquid is potassium hydroxide which could be used for science activities

(b) Calcium Hydroxide

Materials: Quick lime for whitewashing boiling Spoon, bottle, water

Procedures

1. Put five spoons full of powdered lime into a bottle containing about 100ml of water
2. Stir the mixture for some time
3. Allow the mixture to settle
4. Filter content
5. Clear filtered liquid is calcium hydroxide.

Classwork:

What sort of acid or base do Quick Lime and Orange provide?

(c) Preparing indicator from cabbage

Materials:

Procedure

1. Cut red Cabbage,
2. grind it in a blender,
3. Sieve the red liquid and add some water

The red liquid content can be used as an indicator instead of red litmus paper.

Results

Research Questions1

What is the academic performance of students in acids and bases when taught with locally-made and factory-made instructional materials in Rivers State?

Table 1: Mean and standard deviations of post-test students' performance when factory-made and locally-made instructional materials are used in teaching acids and bases in Rivers State?

Instructional material	N	Mean	Standard deviation
Factory-made	51.00	76.98	12.40
Locally-made	46.00	49.27	19.63

Table 1 shows that the mean post-test of students' performance when factory-made and locally-made instructional materials are used in teaching acids and bases in Rivers State with standard deviations are 76.98 and 49.27 with a standard deviation of 12.40 and 19.63. This implies that students taught with locally-made instructional material obtained higher scores on the performance test than those taught with factory-made instructional materials.

Research Questions 2

What is the academic performance of male and female students in acids and bases when taught with locally-made instructional materials salts in Rivers State?

Table 2: Mean and standard deviations of male and female students' performance when locally-made instructional materials are used in teaching acids and bases in Rivers State?

Gender	N	Mean	Std. Deviation
Male	38	63.58	7.65
Female	13	58.70	9.23

From table 2 above, the mean of male and female students' performance when locally-made instructional materials are used in teaching acids and bases are 63.58 and 58.70 with standard deviations of 7.65 and 9.23. This implies that male students perform better than their female counterparts when locally-made instructional materials are used in teaching acids and bases in Rivers State.

Research Questions 3

What is the academic performance of private and public school students in acids and bases when taught with locally-made instructional materials in Rivers State?

Table 3: Mean and standard deviation of private and public school students' performance when locally-made instructional materials are used in teaching acids and in Rivers State?

School type	N	Mean	Std. Deviation
Private	24	62.08	6.56
Public	27	57.77	5.79

From table 3, the mean of private and public school students' performance when locally-made instructional materials are used in teaching acids and bases in Rivers State are 62.08 and 57.77 with a standard deviation of 6.56 and 5.79. This implies that private school students perform better than their public school counterparts when locally-made instructional materials are used in teaching acids and bases in Rivers State.

Hypothesis 1

There is no significant difference in students' performance when locally-made and factory-made instructional materials are used in teaching acids and bases in Rivers State?

Table 4: t-test analysis of post-test mean students' performance when locally-made and factory-made instructional materials are used in teaching acids and bases in Rivers State

Instructional material	N	$\overline{X}$	SD	Df	t-cal.	t – crit.	Sig. level	Decision
Factory-made	51	62.98	14.40	95				
					4.84	1.960	0.05	Rejected
Locally-made	46	49.27	19.63					

From table 4 above, the calculated value of t-cal = 4.84 is greater than the table value which is 1.960. Therefore, the null hypothesis which states that there is no significant difference in students' performance when locally-made and factory-made instructional materials are used in teaching acids and bases in Rivers State is rejected. This implies that the performance of students when locally-made and factory-made instructional materials are used in teaching acids and bases differ significantly.

Hypothesis 2

There is no significant difference in male and female students' performance when locally-made instructional materials are used in teaching acids and bases in Rivers State.

Table 5: t-test analysis of the post-test mean performance of male and female students when locally-made instructional materials are used in teaching acids and bases in Rivers State

Gender	N	$\overline{X}$	SD	df	t-cal.	t – crit.	Sig. level	Decision
Male	38	63.58	12.65	95				
					1.862	1.960	0.05	Rejected
Female	13	58.70	12.95					

From the table above, the calculated value of t-cal = 1.862 is less than the table value which is 1.960. therefore, the null hypothesis which states that there is no significant difference in male and female students' performance when locally-made instructional materials are used in teaching acids and bases in Rivers State is accepted. This implies that the difference in the performance of male and female students when locally-made instructional materials are used in teaching acids and bases is negligible.

Hypothesis 3

There is no significant difference in private and public school students' performance when locally-made instructional materials are used in teaching acids and bases in Rivers State.

Table 6: t-test analysis of the post-test mean performance of private and public school students when locally-made instructional materials are used in teaching acids and bases

School type	N	$\overline{X}$	SD	Df	t-cal.	t – crit.	Sig. level	Decision
Private	24	62.08	12.56	95				
					1.610	1.960	0.05	Rejected
Public	27	57.77	12.79					

From table 3, the calculated value of t-cal = 1.610 is less than the table value which is 1.960. Therefore, the null hypothesis which states there is no significant difference in private and public school students' performance when locally-made instructional materials are used in teaching acids and bases in Rivers State is accepted. This implies that the difference in the performance of private and public school students when locally-made instructional materials are used in teaching acids and bases is negligible.

Discussion of Results

Evidence from the results of this study revealed a significant difference in students' performance when locally-made and factory-made instructional materials are used in teaching acids and bases in Rivers State (Table 4). Students taught with local-made solutions of acids and bases instructional materials performed significantly better than those taught with factory-made instructional materials. This finding corroborates that of Ibe, Obikezie, et.al, (2021), as well as Obi and Obi (2019) in chemistry where it was discovered that chemistry students who received lessons on acids, bases and salts using improvised instructional materials performed significantly better than those taught with standard or factory-made instructional materials as well as high knowledge retention ability of students, taught using improvised materials. The findings further corroborate other findings of other studies by Udogu and Enukora (2017), Omiko (2016) and Ibe (2021) where the use of locally improvised materials in various teaching chemistry concepts caused a significant difference in students' performance when compared to those taught with factory-made instructional materials

Better performance of students that learnt acids, bases and salts with locally-made instructional material in this study, could be because instructional materials were appealing. After all, the students prepared them using local raw mater under the teachers' guidance. This process makes learning real practical and provides a bridge between the world outside and outside the classroom and at the same time encourages students' participation in the learning process. Also, allowing the students to be involved in the construction process for the instructional materials helps to clarify unfamiliar concepts and develop their potential for learning science. Furthermore, apart from the fact that teaching was activity oriented because of the practical activities, the students learn from personal experience which facilitates understanding and permanent storage as well as information retrieval. This is central to the experience of students in the factory-made instructional materials which only bear resemblance to the original material when introduced by the class teacher.

The results of the test of hypothesis 2 (Table 5) revealed that there was no significant gender effect of locally-made instructional materials in the study. These results support the results of the study of Obi and Obi (2019) and Ibe, (2021) where there was no significant difference between the performance of male and female students taught different chemistry concepts with improvised instructional materials. This implies that the use of locally-made instruction material in teaching is not gender-selective and gives credence to its application in teaching science since the optimum goal of any lesson is to ensure proper understanding of the concept by students irrespective of gender. The results of this study support the findings of Obi and Obi (2019; Ibe, 2021) where no significant difference in the mean performance of students taught with instructional materials based on gender was found. Gender consideration plays an important role in the performance of students at all levels of education. A typical classroom mostly in coeducational schools contains boys and girls, therefore it is expected that there should be no disparity in the application of any lesson procedure to offer the students equal chances of competing. The gender nondiscriminatory finding of this study, therefore, validates the authenticity of the use of improvised instructional materials from locally available materials.

The results of the test of hypothesis 3 (Table 6) showed that there was no significant difference in the performance of private and public senior secondary school students taught acids, bases and salts using improvised instructional materials. Private and public schools have always been at variance in terms of the availability of instructional materials mostly in sciences, therefore the discovery of no significant difference in students' performance when taught with improvised instructional materials points to the fact that the use of improvised instructional materials finds its application in both private and public schools.

Conclusion

Locally-made laboratory instructional materials are more effective instructional material than factory-made instructional materials and could serve the same in schools where the ready-made instructional materials are not insufficient or unavailable.

Recommendations

1. Government and cooperate bodies, as well as individuals, should organize a workshop on improvisation for Science teachers to improve and update their competence.
2. Chemistry teachers should always use improvised instructional materials in teaching chemistry whenever the materials are not available.
3. Teachers should be trained on how to improvise chemistry instructional materials

Contributions to knowledge

1. The results of this study provide the solution to the problem of lack of instructional materials in our schools.
2. It provides, teachers with possible ways of arriving at effective lesson delivery in the absence of factory-made instructional materials
3. it provides a solution to the problem of teachers' overdependence on factory-made instructional materials for lesson delivery.

References

1. Abdu-raheem, B. O. (2016). Effects of instructional materials on secondary school students' academic achievement in social studies in Ekiti State, Nigeria. *World Journal of Education*, 6(1), 32-39.
2. Adu, F.O & Adu E. I (2014). Improvisation as a tool for improving the teachers' Knowledge in basic technology. *Journal of Research & Method in Education, 4(1), 14 -18.*
3. Aina, K. J. (2013). Instructional materials and improvisation in physics class: implications for teaching and learning. *Journal of Research & Method in Education, 2*(5), 38-42.
4. Ausubel, D. P. (1963). The use of advance organizer in learning and retention of meaningful verbal materials. *Journal of Educational Psychology, 51*, 267-272.
5. Awolaju, B. A. (2016). Instructional materials as correlates of students' academic performance in chemistry in senior secondary schools in Osun State. *International Journal of Education Technology*, 6(9), 705-707.
6. Ibe, F. N. (2021). Effect of improvised instructional materials on chemistry students' academic retention in secondary school**.** *International Journal of Research in Education and Sustainable Development*, 1(5),19-31.
7. Igiri, C. E. & Effiong, O. E. (2015). Impact of instructional materials in teaching and learning of chemistry in senior secondary schools in Yakurrr Local Government Area. *International Letters of Social and Humanistic Science*, 62, 27-33.

8. Iji, C.O., Ogbole, P.O. & Uka, N. K. (2014). Effect of improvised instructional materials on students' achievement in geometry at the upper basic education level in Markudi Metropolis, Benue State. *Educational Research and Reviews,* 9(15), 504-509.

9. Kira, E. (2016). Improvisation in teaching physics concepts: teachers' experiences and perceptions. *International Journal of Research Studies in Educational Technology*, 5(1), 49-61.

10. Mbah, M. I. (2013). Use of instructional materials and educational performance of student in integrated science (A case study of unity schools in Jalingo, Taraba State, Nigeria. *Journal of Research & Methods in Education*, 3(4), 7-11.

11. Mberekpe, A.C. (2013). Effect of students improvised instructional materials on senior secondary school chemistry student's achievement. *University of Nigeria Virtual Library*. Retrieved December 10 2019 from http://www.educationaltechnology.principle/doc.

12. Mboto, F. A., Ndem, N. U. & Stephen, U. (2011). Effect of improvised materials on students' achievement and retention of the concepts of radioactivity. *African Research Reviews*, 15(1), 18, 342-353.

13. Obi, N. C. & Obi J. J. (2019). Effects of improvised instructional materials on academic achievement of SS1 chemistry students in Cross River State Nigeria. *International Journal of Applied Sciences,* 5(7), 444-448.

14. Okori, O. A. & Omenka, J. (2017). Improvisation and utilization of resources in the teaching and learning of science and mathematics in Secondary Schools in Cross River State. *Global Journal of Educational,* 16, 21-28.

15. Oladejo, M. A., Olosunde, G. R, Gbolagade R. Ojebisi, A.O. & Olawole, M. (2011). Instructional materials and students' academic achievement in physics: Some policy implications. *European Journal of Humanities and Social Sciences,* 2 (1), 112- 126.

16. Olatoye, R. A. (2017). Effect of teaching using charts, real specimens and videos on secondary school students' achievement in mammalian skeletal system concepts. *ENSAYOS, Revista de la faculted de education de albcete*, 32(2), 63-75.

17. Omiko, A. (2016). Investigating the availability and the extent of use of instructional materials by secondary school chemistry teachers in Nigeria. *European Journal of Humanities and Social Sciences,* 1 (1), 112- 126

18. Otor, E. E., Ogbeda, J. & Ityo C. N. (2015). Influence of improvised instructional materials on chemistry students' academic performance in senior secondary schools in Vandeikya Local Government Area of Benue State. *International Research in Education*, 3(1), 111-118.

19. Oyediran, (2010). Improvisation of Science Teaching Resources. *Proceedings of the 40th Annual Conference of Science Teachers' Association of Nigeria (STAN) (PACS'10) Kano Nigeria*, 55 – 60.

20. Udogu M. E. & Enukora, E. (2017). The efficacy of locally improvised materials and home activities on students' achievement and retention in chemistry. *Journal of Science and Technology* 2(3), 30-41.

