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An investigation into students' attitudes towards improvisation of instructional materials in Basic Science and Technology in Lagos State Schools

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Abstract
This study examined students' attitudes toward the use of improvised instructional materials in Basic Science and Technology. A quasi-experimental design, complemented by a descriptive survey, was employed to assess the attitudes of students exposed to an improvised alternating current generator (IACG) during instruction compared to those who received conventional teaching. A total of 360 Basic 9 students were randomly selected from six public junior secondary schools across Lagos State. Research instruments included the IACG, a lesson plan, and a structured questionnaire. These instruments were validated and pilot tested, with the questionnaire yielding a reliability coefficient of 0.88 using Cronbach's Alpha. Findings revealed a statistically significant difference in attitudes between the experimental and control groups, indicating a more favorable disposition toward improvisation among students taught with the IACG. Based on these findings, it is recommended that schools regularly integrate improvised instructional materials into science teaching. Furthermore, both schools and families should encourage students to engage in improvisation activities to enhance practical understanding and innovation in science education across Lagos State and beyond.

INTRODUCTION

Students' exposure to and experiences with their immediate and remote environment significantly influences their attitude and behavioral changes towards learning new skills and knowledge at their respective schools and homes. Students develop different attitudes toward instructional technology tools based on their teachers' teaching competency with the right technology (U.S. Department of Education, 2021). Dakpa (2024) and Blazar & Kraft (2017) noted that the teachers are the key factor in determining the quality of instructional deliveries which students receive in alignment with the availability of instructional materials of either ready-made or teachers improvised type. Teachers` teaching and practical demonstration of subjects related to practical activeness are strongly based on availability of curriculum materials and teachers' usage, maintenance and improvisation of school facilities, equipment, and instructional materials.

Teachers' motivation of students through improvisation of instructional materials is highly needed in teaching and learning of science and technology subjects/courses in all levels of education. Blazar & Kraft (2017), Cheng (2001), Jalongo-Lamberski (2000), Strom (2014), and The Classroom Store (2021) stated that the classrooms are said to be dynamic, interactive, encouraging environment for students to develop constructive attitude towards appropriate instructional materials and learn the subject's matter effectively. Teachers face different instructional challenges in their daily classroom activities which are necessary to resolve critically with their professional competencies and usage of improvised instructional materials whenever ready-made instructional materials are unavailable. Adu & Adu (2014), Jalongo-Lamberski (2000), Ndihokubwayo et al. (2018), Nnorom & Obianuju (2021), and Ogunleye (2000) confirmed that the realization of dynamic, productive, innovative, and engaged classroom instructional activities has never been achieved by only "ready-made" instructional materials without inclusion of the "homemade" and "improvised" instructional materials.

The complete implementation of the Basic Science and Technology curriculum and excellent student performance are achieved through several key factors: professional and competent teachers, appropriate student age and readiness, availability of instructional materials (either through procurement or improvisation), and effective utilization of these resources for teaching and learning (Adegoke, 2019).

In Nigeria's Universal Primary Educational System (UPE), Introductory Technology was established as one of the core pre-technical and vocational subjects at the Junior Secondary School level. According to the Federal Ministry of Education (2004), its purpose was to expose Nigerian youth to innovative and appreciative technology, potentially boosting their interest in vocations and trades upon completing junior secondary school and eventually advancing to professional careers. Subsequently, within Nigeria's Universal Basic Educational System, Introductory Technology was renamed as Basic Technology for Upper Basic Education.

According to the Federal Ministry of Education (2007), this curriculum aimed to:

c) Inculcate technological literacy—developing a basic understanding of and capability in technology
c) Expose students to the world of work, helping them match their talents and interests for wise vocational choices
c) Foster positive attitudes toward work as a source of human identity, livelihood, and power.

The revised Basic Science and Technology curriculum for Upper Basic Education incorporates nine essential themes: You and Technology, Safety, Materials and Processing, Drawing Practice, Tools and Machines, Applied Electricity and Electronics, Energy and Power, Maintenance, and Building. This structured approach ensures a comprehensive foundation in technological education for Nigerian students.

LITERATURE REVIEW

Improvisation in Science, Technology, Engineering and Mathematics (STEM) Education.

Etymologically, *improvisations* are derived from the word *improvise*. Improvise according to the Oxford Learner's Dictionaries (2024) means "to make or do something using whatever is available, usually because you do not have what you need." Also, Encarta Dictionaries (2008) defined improvise as a means "to make a substitute for something out of materials that happen to be available at the time." Brown and Edelson (2003) postulated that improvisations normally arise in the classroom when a teacher identifies additional opportunities to facilitate instructional activities that will boost students' acquisition of subjects' related knowledge and skills. In addition, according to the Commonwealth (1997), improvisation is a significant feature of Science, Technology, Engineering and Mathematics (STEM) education. It encompasses scientific strategies and processes like problem identification and solving, planning, designing, evaluating and decision making which are all imperative for living in the contemporary world. Nnorom & Obianuju (2021) and Ogunleye (2000) opined that improvisation in science teaching is a way of substituting, replacing, or supplementing standard materials with locally available materials or resources. Improvisation is the strategy of using alternative accessible materials and resources for instructional implement science and technology concepts and carry out all the related practical activities effectively whenever there is shortage or lack of some specific firsthand resources.

Improvisation in STEM education as noted by Nnorom & Obianuju (2021) and Ndihokubwayo et al. (2018) means the propagation of skills and knowledge between teachers and students, involving transformation and recycling of waste materials into useful instructional materials. Improvisation in STEM education extensively enhances innovation, critical thinking, resourcefulness, hands-on learning, adaptability to different contexts, and confidence building. Nnorom & Obianuju (2021), Ndihokubwayo et al. (2018) and Ogunleye (2000) exemplified improvisation in STEM education to involve the use of balloons, straws, plastic bottles, a torch-light and broken magnets to demonstrate basic physics concepts; using kerosene stove as a Bunsen burner during chemistry practical; transform old eyeglasses and cardboard to a simple microscope; using local gin as a substitute for concentrated ethanol; using low-cost available materials to build small-scale prototypes. This authenticates that majority of improvisation raw materials for STEM education instructional activities can be found at home, radio-repair shop, hardware shop, food and materials market, automobile repair shop, office, the school laboratory, school environment, bicycle repair shop, and the locality by teachers, students, and parents.

Concept of Instructional materials

California Department of Education (2024) stated that Instructional materials were described by the Education Code Section 60010 as "all materials that are designed for use by pupils and their teachers as a learning resource and help pupils to acquire facts, skills, or opinions or to develop cognitive processes. Instructional materials may be printed or non-printed, and may include textbooks, technology-based materials, other educational materials, and tests." The Classroom Store (2021) and Nwosu (1995) described instructional materials as informative mediation tools for the dissemination of instructional information from teachers to learners at all academic institution environments for the fulfillment of the intended instructional objective(s). Nwosu (1995) further described instructional materials as educational facilitators of teaching and learning activities whenever they are properly and productively utilized for the acquisition of worthwhile skills and knowledge. Instructional materials are any form of informative materials which have appealing potential to all senses and feelings for the acquisition of tangible learning objectives. Science and engineering equipment, apparatuses, and consumable materials (chemicals & emery cloth) also qualify as instructional materials. Folorunso (2004) stated that Instructional materials in technical and engineering education are classified into tools (hand and machine tools), equipment (forge, guillotine & testing equipment), and consumable materials (sandpaper & lubricating oils).

Abolade (1998) defined instructional materials as entirely educational resources tools that facilitate the transmission and acquisition of skills and knowledge in a dignified system of education. The instructional aids as opine by the Classroom Store (2021), Abolade (1998), and Nwosu (1995) can be classified under the following categories: (a) print materials (includes professionals' publications such as textbooks, revision notes, pamphlet, workbooks, assignment file, and exercises, magazines, educational journals, practice sets, manuals, reference books, and other periodicals; (b) electronics, technology, and media devices (includes devices that significantly transform notebooks and chalkboards into the usage of electronic teaching tools such as the Learning Management System (LMS) and Laboratory Information Management System (LIMS)); (c) visualizations and graphics (includes real objects, infographics, graphic organizers, and other supportive visuals like photographs, maps, and transparencies); (d) games and interactive resources (includes games, learning placemats, role-play, puzzles, Knovel and Engineering Village, and brainteasers.); (e) community, financial, and shared resources (includes volunteers, engineers, health workers, libraries, marketplaces, religious instructions, industrial concerns amusement parks, museum, and community centers.); (f) graphic and interactive materials (includes photographs, illustrations, graphs, charts, maps, movies, multimedia, and games.); presentation items (includes slideshow applications, lecture notes, interactive presentation software like Prezi, Canva, Deck and Pear); (g) tests and assessments materials (includes classroom assignments, quizzes, essays, group projects, and standardized tests).

Theoretical Framework: Social Learning Theory by Albert Bandura

This study adopts Albert Bandura's Social Learning Theory (SLT) which underscores the importance of observation, imitation, and modeling in shaping human behavior and learning. Bandura proposed that individuals learn through their individual experiences and by watching others and noting the values of their actions. Integrating cognitive and behavioral perspectives, SLT explains that individuals actively process information, and their actions are shaped by internal factors and environmental influences (Psychology, 2024). A key concept introduced by Bandura is *reciprocal determinism*, which illustrates the dynamic interaction among personal, behavioral, and environmental factors in shaping learning. The key mechanisms of social learning theory include:

1. **Observation and Modeling**: People learn by witnessing the actions of role models, such as peers, teachers, or influential figures.
2. **Reinforcement and Motivation**: Positive or negative reinforcement, coupled with expectations of similar outcomes, influences whether observed behaviors are imitated.
3. **Self-Efficacy**: Central to SLT, this refers to an individual's confidence in their ability to prosper in specific tasks, directly impacting learning and performance (Psychology, 2024).

This study explores students' attitudes toward improvisation in Basic Science and Technology education, aligning closely with SLT. Observational and interactive teaching methods significantly shape students' learning experiences. For instance, using an improvised Alternating Current Generator as a teaching tool provides students with an active learning experience through demonstration and practice.

1. **Role of Observational Learning**: Observing the improvised generator's functionality can influence students' attitudes based on their perception of its effectiveness, as well as the behaviors and attitudes demonstrated by their teachers.

2. **Influence of Social Context**: SLT highlights the role of the classroom environment, where teacher-student interactions and peer collaboration shape attitudes and outcomes.

In promoting engagement through interactive and observational methods, the use of improvisation aligns with SLT principles, supporting the study's framework.

The SLT has been integrated into technology Education, Bell et al. (2013) show how technology-enhanced teacher training programs leverage SLT by emphasizing observational and contextual learning. This parallels the current study's use of improvised tools to enhance science education. Brauer and Tittle (2012) using SLT explored how reinforcement works within SLT to influence behavior. Their findings reinforce the idea that improvised teaching materials can positively affect students' attitudes and engagement. However, Higgins, et al. (2006) applied SLT to behaviors like digital piracy, demonstrating the influence of observational learning and environmental factors. Similarly, students' attitudes in this study are shaped by their exposure to innovative teaching methods and resources.

Social Learning Theory provides a robust framework to analyze how students' attitudes toward improvisation develop in a classroom context. By focusing on the impact of observable learning and social dynamics, SLT explains how exposure to improvised tools and teacher-modeled attitudes can lead to meaningful changes in perception and engagement. The theory also highlights the importance of interactive and context-driven learning, which are vital in practical subjects like Basic Science and Technology. Moreover, it underlines the role of teacher self-efficacy in implementing creative strategies, Wang et al. (2024)) emphasis on the effectiveness of teacher-developed materials.

Albert Bandura's Social Learning Theory offers a comprehensive lens to understand how students' attitudes toward improvisation in science education are influenced by observation, modeling, and reinforcement. By framing the study within SLT, the findings provide deeper insight into how innovative teaching strategies affect learning outcomes and engagement.

Statement of the Problem

Improvised instructional materials are purposely provided to reinforce teachers' verbal presentation of facts and ideas in classroom activities in some situations where real objects (realia) are not readily available. During classroom activities, students are bound to develop either positive or negative attitudes toward instructional materials whenever there are perfect alignments or non-alignments between material design and instructional objectives. Currently, most students at Upper Basic Schools have little or no interest in the improvisation of instructional materials and develop a negative attitude toward improvisation. Also, teachers, students, school management and society at large have parochial knowledge and skills of transforming materials in their contemporary environment into instructional materials in the name of improvisation.

This study therefore attempts to investigate the students' attitudes towards improvising Basic Science and Technology instructional materials in some Lagos State Upper Basic Schools.

Purpose of the Study

This study examined students' attitudes towards improvising Basic Science and Technology instructional materials.

Research Questions

The research question for this study is what are the students' attitudes towards improvising Basic Science and Technology instructional materials?

Statement of Hypothesis

The following null hypothesis was tested:

Ho 1: There will be no significant differences in students 'attitude toward improvisation between students taught with an improvised Alternating Current Generator and those not taught with an improvised Alternating Current Generator.

METHODS

Research Design

This study adopted a quasi-experimental design complemented by a descriptive survey approach to investigate students' attitudes toward the improvisation of instructional materials in Basic Science and Technology in selected schools in Lagos State. The quasi-experimental component involved a comparison between two groups: an experimental group exposed to instructional activities utilizing an *Improvised Alternating Current Generator* (IACG), and a control group that received conventional instruction without the use of the improvised material.

The study focused on four key instructional content areas within the Basic Science and Technology curriculum:

(a) Principles underlying appliances that convert mechanical energy into electrical energy;

(b) Identification of common appliances that operate on mechanical-to-electrical energy conversion;

(c) Recognition and naming of the parts of a simple alternating current generator; and

(d) Demonstration and explanation of the working principle of a simple alternating current generator.

Instructional activities for both groups were facilitated by Basic Science and Technology teachers who had been adequately briefed on the lesson content and instructional procedures. The teaching sessions were delivered over two consecutive class periods, totaling 80 minutes per school. While the experimental group received instruction that incorporated the IACG to illustrate concepts practically, the control group was taught the same content using standard instructional methods without the use of the improvised device.

The survey component of the study was employed to assess students' attitudes following the instructional intervention, providing additional insight into their perceptions regarding the use of improvised instructional materials in science teaching.

Study Area

The study was conducted across six educational districts within Lagos State, Nigeria. To ensure representation across diverse geographical and administrative zones, one public junior secondary school was purposively selected from each district. The selected schools were:

(a) Imoye Junior High School (IJHS), Mile 2, representing the Amuwo-Odofin Local Government Area;

(b) International Secondary School (ISL), University of Lagos, representing the Mainland Local Government Area;

(c) Ransome-Kuti Memorial Junior Grammar School (RMJGS), located in Mushin under the Mushin Local Government Area;

(d) Gbagada Comprehensive Junior Secondary School (GCJSS), situated in Gbagada within the Shomolu Local Government Area;

(e) State Junior High School (SJHS), Abesan Estate, representing the Alimosho Local Government Area; and

(f) King Ado Junior Secondary School (KAJSS), Ojo-Giwa, representing the Lagos Island Local Government Area.

These schools were selected based on their accessibility, willingness to participate, and administrative alignment with the designated educational districts, thereby ensuring a balanced distribution across the state.

Population, Sample and Sampling Technique

The target population for this study comprised all Basic 9 students enrolled in public Upper Basic Education schools across the six educational districts of Lagos State. A total of 360 students were selected through a stratified random sampling technique to serve as the study sample. The sample was divided equally into experimental and control groups. The experimental group consisted of 180 students, drawn from three schools: Imoye Junior High School (IJHS), International Secondary School (ISL), and Ransome-Kuti Memorial Junior Grammar School (RMJGS). Similarly, the control group comprised 180 students selected from Gbagada Comprehensive Junior Secondary School (GCJSS), State Junior High School (SJHS), and King Ado Junior Secondary School (KAJSS). From each school, 60 students were randomly selected from the Basic 9 (terminal) class to participate in the study. The selection ensured adequate representation of the broader student population across the districts, thereby enhancing the generalizability of the study's findings to the entire population of Basic 9 students in Lagos State government schools.

Research Instrument

Three research instruments were utilized in this study: the Improvised Alternating Current Generator (IACG), the Basic Science and Technology Lesson Plan (BSTLP), and the Basic Science and Technology Students' Attitude Questionnaire (BSTSAQ). The Improvised Alternating Current Generator (IACG) functioned as a hands-on, construction-based instructional aid designed to supplement the teaching of concepts related to electricity generation. The device was fabricated over a one-month period at the Physics Workshop of the Department of Physics, Faculty of Science, University of Lagos. Its construction involved the use of both hand and machine tools, with all materials sourced locally. The IACG was specifically built to demonstrate the principles of mechanical-to-electrical energy conversion, and it served as a tangible resource to enhance students' understanding of alternating current generation. Details of its components and specifications are provided in Appendix 1, Table 1, and the device is illustrated in Figures 1 and 2.

The Basic Science and Technology Lesson Plan (BSTLP) was developed in alignment with the national Basic Science and Technology curriculum for Basic 9 students. It was structured to support systematic delivery of content during instructional sessions involving both the experimental and control groups. The lesson plan focused on four key thematic areas:

1. Principles behind the operation of appliances that convert mechanical energy into electrical energy.
2. Identification of household and industrial appliances that rely on mechanical-to-electrical energy conversion.
3. Recognition and labeling of parts of a simple alternating current generator; and
4. Demonstration and explanation of the working principle of a simple alternating current generator.

This structured lesson plan ensured uniform content coverage and instructional objectives across all participating schools.

The third instrument, the Basic Science and Technology Students' Attitude Questionnaire (BSTSAQ), was designed to measure students' perceptions and attitudes toward the use of improvised instructional materials. The questionnaire consisted of 10 items, each rated on a five-point Likert scale, ranging from *Strongly Agree* to *Strongly Disagree*. To ensure the instrument's validity, it underwent expert review for content and construct alignment. A pilot test was also conducted to assess reliability, and the resulting Cronbach's Alpha coefficient was 0.88, indicating a high degree of internal consistency.

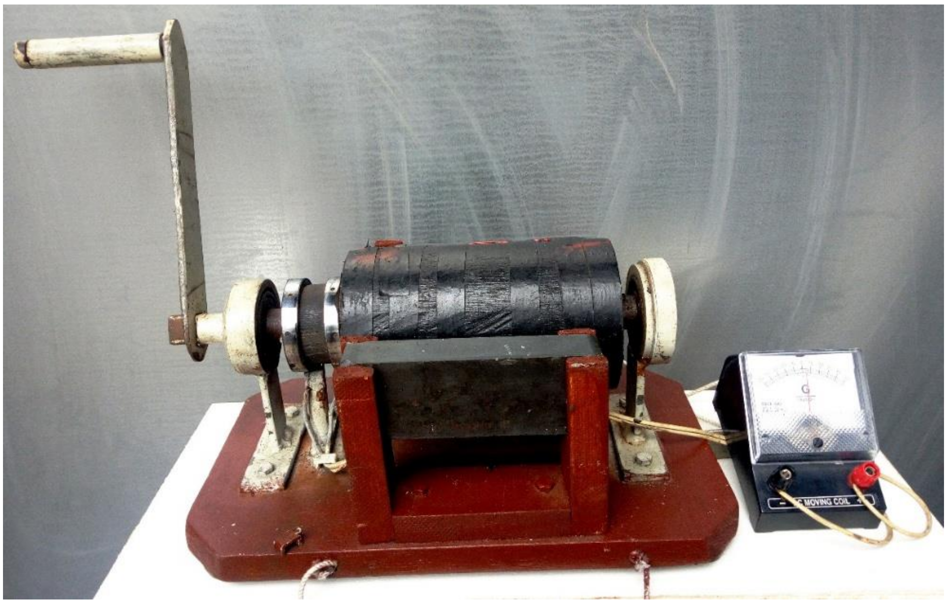

Figure 1. Improvised Alternating Current Generator

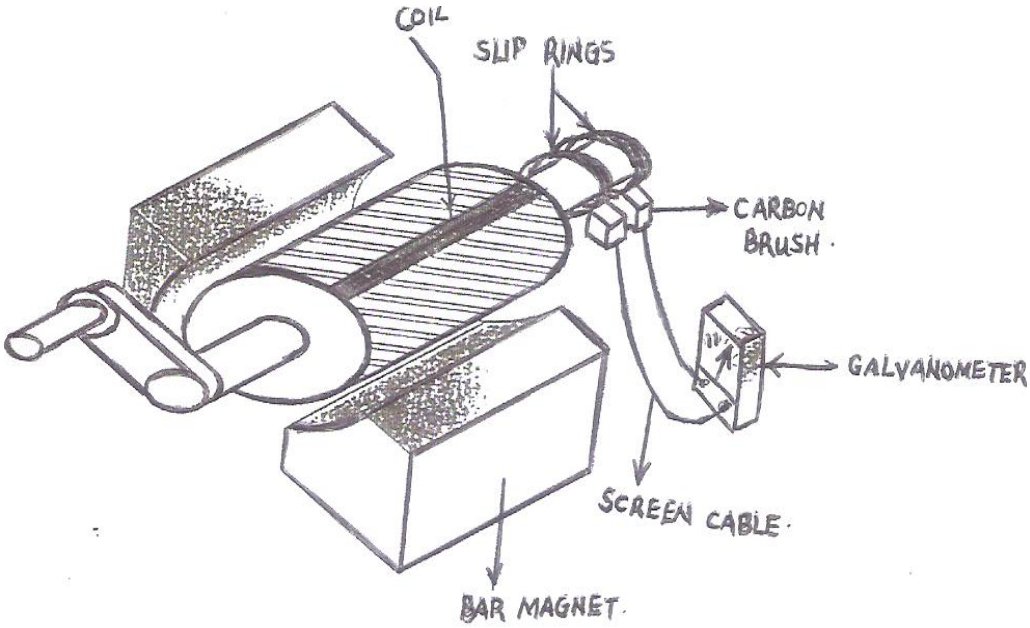

Figure 2. Schematic Diagram of the Improvised Alternating Current Generator

RESULTS

Table 2. Item – by – Item analysis of questionnaire of control and experimental groups students' attitude towards improvisation of Instructional materials.

S/N	Questionnaire Items	Group	Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree	Mean	Standard Deviation	Decision
1	I prefer learning with improvised Instructional materials.	**C**	0	15	5	80	80	1.75	40.53	Rejected
		E	80	45	5	20	30	3.69	28.59	Accepted
2	Improvised Instructional materials boost my interest in practical activities.	**C**	0	10	10	85	75	1.75	40.53	Rejected
		E	75	60	20	10	15	3.94	29.45	Accepted
3	Instructional materials improvised in my presence improve my creativity.	**C**	60	80	0	20	20	3.78	32.86	Accepted
		E	85	55	5	15	20	3.94	33.24	Accepted
4	Improvised instructional materials increase my analytical thinking when I am involved in making those needed materials.	**C**	75	85	0	10	10	4.14	40.53	Accepted
		E	80	45	5	20	30	3.69	28.59	Accepted
5	I feel successful in Basic Science and Technology class if I am involved in improvisation.	**C**	25	30	5	60	60	2.44	23.82	Rejected
		E	80	45	5	20	30	3.69	28.59	Accepted
6	I acquired a scientific attitude whenever I was exposed to improvised instructional materials.	**C**	35	45	20	40	40	2.97	9.62	Rejected
		E	80	45	5	20	30	3.69	28.59	Accepted
7	I always value sharing ideas or solving problems with improvised instructional materials.	**C**	25	35	50	40	30	2.92	9.62	Rejected
		E	65	85	5	10	15	3.97	36.47	Accepted
8	In the absence of real things, instructional materials improvised presents next to real situation to me.	**C**	25	35	50	40	30	2.92	9.62	Rejected
		E	80	45	5	20	30	3.69	28.59	Accepted
9	My teacher usually improvised whenever my school was short of instructional materials.	**C**	10	5	5	75	85	1.78	40.37	Rejected
		E	75	88	12	5	0	4.29	42.01	Accepted
10	I improvised some instructional materials with household materials.	**C**	0	0	0	60	120	1.33	53.67	Rejected
		E	75	85	0	10	10	4.14	40.53	Accepted

Note: C represents **Control Group**; **E** represents **Experiment Group**.

The results presented in Table 2 provide a comparative analysis of students' attitudes toward the use of improvised instructional materials in Basic Science and Technology across the control and experimental groups.

Students in the control group generally expressed unfavorable attitudes toward the use of improvised materials. They disagreed with statements related to preference for improvised materials (M = 1.75, SD = 40.53), increased interest in practical activities (M = 1.75, SD = 40.53), sense of success in science classes when involved in improvisation (M = 2.44, SD = 23.82), development of scientific attitudes (M = 2.97, SD = 9.62), value placed on collaborative problem-solving using improvised tools (M = 2.97, SD = 9.62), and the perception of improvised materials as realistic substitutes (M = 2.97, SD = 9.62). Similarly, they reported low agreement with teacher-led improvisation during material shortages (M = 1.78, SD = 40.37) and personal engagement in improvisation using household items (M = 1.33, SD = 53.69). However, they acknowledged that improvised materials enhanced their creativity (M = 3.78, SD = 32.86) and promoted analytical thinking (M = 4.14, SD = 40.53).

In contrast, students in the experimental group demonstrated consistently positive attitudes across all measured indicators. They reported strong agreement with statements reflecting preference for improvised instructional materials (M = 3.69, SD = 28.59), increased interest in practical science tasks (M = 3.94, SD = 28.59), enhanced creativity (M = 3.94, SD = 33.24), and improved analytical thinking (M = 3.69, SD = 28.59). Additionally, they expressed a sense of achievement in science lessons involving improvisation (M = 3.69, SD = 28.59), acquisition of scientific attitudes (M = 3.69, SD = 28.59), appreciation for problem-solving using improvised resources (M = 3.97, SD = 36.47), and recognition of improvised materials as credible alternatives to real-life equipment (M = 3.69, SD = 28.59). High levels of agreement were also recorded regarding teachers' use of improvisation during material shortages (M = 4.29, SD = 42.01) and students' own use of household items for improvisation (M = 4.14, SD = 40.53).

Overall, the data underscore a notable contrast between the experimental and control groups, with the former displaying a significantly more favorable attitude toward the use and value of improvised instructional materials in science education.

Table 3. Group statistics of experimental group and control group students' attitude toward improvisation of instructional materials.

	Group	N	Mean	Std. Deviation	Std. Error Mean
Score	Experimental	10	3.8730	0.21884	0.06920
	Control	10	2.5750	0.93008	0.29412

As presented in Table 3, the experimental group exhibited a more favorable attitude toward the improvisation of instructional materials, with a mean score of 3.87, standard deviation (SD) of 0.22, and standard error of the mean (SEM) of 0.07. In contrast, the control group recorded a lower attitude score, with a mean of 2.58, standard deviation of 0.93, and standard error of the mean of 0.29. These results indicate a substantial difference in attitudes between the two groups, suggesting that exposure to improvised instructional materials positively influenced students' perceptions and engagement in Basic Science and Technology instruction.

Table 4. Independent Samples T-test of students' attitude toward improvisation of instructional materials between experimental group and control group.

	Levene's Test for Equality of Variances		t-test for Equality of Means				
	F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference

Equal variances assumed	15.022	.001	4.296	18	.000	1.29800	.30215
Equal variances not assumed			4.296	9.993	.002	1.29800	.30215

As shown in Table 4, Levene's test for equality of variances yielded an F-value of 15.022 with a corresponding p-value of .001, which is less than the established significance level ($\alpha = 0.05$). This indicates a significant violation of the assumption of equal variances. Consequently, the results of the independent samples t-test under the condition of unequal variances were interpreted. The analysis revealed a statistically significant difference in students' attitudes toward improvisation between the experimental and control groups, with $t(9.993) = 4.296$, $p < .001$.

Based on this result, the null hypothesis stating that *there would be no significant difference in students' attitudes toward improvisation between those taught with an improvised Alternating Current Generator and those taught without it* is rejected. This finding confirms that the use of improvised instructional materials had a significant positive impact on students' attitudes in Basic Science and Technology.

Discussion of Findings

The study revealed compelling insights into how students' attitudes toward improvised instructional materials in Basic Science and Technology education are shaped by their exposure to and engagement with these materials. Our analysis across multiple dimensions consistently showed more positive attitudes in the experimental group compared to the control group.

Impact of Improvised Materials on Learning

Bandura's concept of reciprocal determinism explains how personal factors, behavior, and environmental influences interact in a dynamic relationship (Bandura, 1986). The data revealed a statistically significant difference in attitudes between students taught with improvised materials versus those who were not ($t = 9.993$, $p < 0.05$). The experimental group's notably higher mean scores ($M = 3.873$, $SD = 0.21884$) compared to the control group ($M = 2.575$, $SD = 0.93008$) clearly demonstrate that exposure to improvised materials positively influenced student attitudes. These findings align with previous research showing that teacher-developed materials create stronger learning connections than pre-manufactured ones (The Classroom Store, 2021; Blazar & Kraft, 2017; Strom, 2014; Cheng, 2001 & Jalongo-Lamberski, 2000)). They also reinforce recent work on how improvisation enhances science education engagement (Dakpa, 2024). The improvised materials created an environmental change that influenced students' attitude and personal factors behavior, which in turn affected how students interacted with their environment thereby improving their learning outcome as a result of their engagements and interactions in Project-Based Learning (PBL), and Inquiry-Based Science Instruction via improvised instructional materials (Sukackė et al., 2022 & Nilson, 2010).

Development of Scientific Skills and Attitudes

Bandura (1977) proposed that individuals learn by observing others' behaviors, attitudes, and outcomes. The result shows the experimental group demonstrated markedly higher ratings across Creative thinking development, Analytical skill enhancement, Scientific attitude cultivation, and Problem-solving capabilities. This supports the idea that successful improvisation happens when teachers can identify opportunities and have the knowledge to explore new instructional approaches (Brown & Edelson, 2003), and as a means of problem-solving in STEM education instructional activities

(Commonwealth, 1997). This also facilitates students improvisation competitions and exhibitions skills extensively.

Practical Implementation and Student Engagement

This study found a strong connection between hands-on improvisation involvement and increased student interest. The experimental group's significantly higher engagement levels (M = 3.94, SD = 28.59) during practical activities with improvised materials align with research showing the benefits of interactive teaching methods (Blazar & Kraft, 2017). This according to Bandura's theory reflects improved self-efficacy, which resulted in the experimental groups higher ratings in creative thinking, analytical skills, scientific attitude cultivation, and problem-solving capabilities (Bandura, 1997). When students successfully engage with improvised materials, they develop confidence in their abilities, reinforcing what Bandura described as performance accomplishments. This is the most influential source of efficacy information.

Teacher Role and Resource Utilization

The data highlighted teachers' crucial role in successful implementation. The experimental group reported much higher rates of teacher involvement (M = 4.29, SD = 42.01) compared to the control group (M = 1.78, SD = 40.37), supporting previous findings about teacher quality's importance in educational effectiveness (U.S. Department of Education, 2021). This aligns with Bandura's theory which emphasizes teachers as an influential model and source of reinforcement in the teaching and learning process. Darling-Hammond et al. (2020) emphasized that teachers who actively engage in instructional innovation create more effective learning environments. When teachers demonstrate enthusiasm and engagement with improvised materials, students are more likely to value and engage with these materials themselves, illustrating what Bandura called vicarious reinforcement. Ifeoma & Onwioduokit (2022) stated that the teachers can exceptionally serve as models for creative and innovative students' attitude development by showing them the process and procedures of instructional improvisation in their respective schools.

Our findings strongly support Bandura's Social Learning Theory, particularly regarding how observational learning and hands-on experience influence student attitudes. The positive responses to teacher demonstrations and practical involvement clearly align with the theory's core principles.

Educational Implications

Based on our research results, we would like to highlight the key implications for science education and future research directions. Our findings suggest we need to focus on four critical areas: implementing systematic teacher training in improvisation techniques, increasing hands-on activities with improvised materials, creating more supportive school environments, and developing better approaches for resource-constrained settings. While these results are promising, there are several important questions that future research needs to address. We need to understand the long-term impact on student achievement - do these benefits persist? We also need to examine how improvisation effectiveness varies across different grade levels, as what works for one age group may not work for another. Additionally, we need to evaluate the cost-effectiveness of improvisation programs and determine the specific training requirements that would best prepare teachers to implement these methods successfully.

Connections between the findings and theoretical framework (Social Learning Theory, SLT)

In synthesizing the theoretical and empirical components, it becomes evident that Bandura's Social Learning Theory (SLT) offers a compelling explanation for the outcomes of this study. The positive effects observed among students in the experimental group can be directly linked to their exposure to teacher-modeled improvisation, the supportive learning environment that encouraged experimentation, and their growing belief in their own abilities to replicate these practices. These factors collectively reflect the mechanisms of SLT and affirm the theory's relevance in contemporary science education.

Thus, the study not only supports the application of SLT in understanding student learning behaviors but also provides empirical evidence that intentional use of improvised instructional materials, supported by active teacher modeling, can be a transformative strategy in shaping students' engagement and attitudes toward science.

Limitations of the Study

Although this study provides meaningful insights into the influence of improvised instructional materials on students' attitudes and engagement in Basic Science and Technology, several limitations must be considered when interpreting the results. One significant limitation lies in the reliance on self-reported data as the primary means of measuring students' attitudes. Despite the validation and high reliability coefficient (α = 0.88) of the Basic Science and Technology Students' Attitude Questionnaire (BSTSAQ), responses obtained through self-report instruments are susceptible to social desirability bias. Students may have felt compelled to provide responses they believed would be viewed favorably by teachers or researchers, rather than offering candid reflections. This possibility could have influenced the elevated attitude scores observed among students in the experimental group.

Another potential limitation is the presence of the Hawthorne effect, wherein participants alter their behavior due to the awareness of being observed or treated differently. The introduction of the Improvised Alternating Current Generator (IACG) and the focused attention received during the intervention may have contributed to the increased enthusiasm and engagement displayed by the experimental group. It is therefore challenging to isolate the effects of the instructional material from the novelty or perceived prestige of participation in the experimental group. Furthermore, the scope of generalization is constrained by the study's sampling design. Although schools were selected from each of the six educational districts in Lagos State, only one school per district was included in the sample. While care was taken to ensure adequate representation, the findings may not comprehensively reflect the diversity of educational settings across the entire state or beyond.

Finally, the study evaluated immediate, short-term outcomes following the instructional intervention. Although positive attitudinal changes were observed, the long-term effects of using improvised instructional materials on sustained student interest, academic achievement, and science learning retention remain unknown. Future studies incorporating longitudinal tracking would be essential to determine whether these initial gains persist over time and influence broader educational outcomes.

CONCLUSION

The effective development of students' attitudes toward the improvisation of instructional materials within the school system is largely dependent on several interrelated factors. These include the competency of teachers, the availability of appropriate tools and equipment, and institutional support from school authorities. For improvised instructional materials to be impactful, they must align closely with the subject content and address the specific instructional needs of students. Consequently, the successful integration and utilization of improvised materials in classroom settings are contingent upon the active participation of both teachers and learners. When educators are well-equipped and supported, and students are engaged in hands-on learning, the use of improvised materials becomes not only effective but also essential in enhancing teaching and learning outcomes.

Recommendations and Suggestions for further Studies

It is optimistic that the following recommendations will improve students' attitude toward improvisation of Instructional materials in Basic Science and Technology in some Lagos state Upper Basic schools and other citadel of learning within and outside Nigeria. Based on the outcomes and limitations of this study, following recommendations were suggested:

1. Future research should incorporate multiple data sources for students' attitude assessment such as peer assessments, classroom observations, teacher evaluations, and behavioral checklists.
2. Subsequent research design studies should consider the Hawthorne effect using delayed post-tests or integrating the intervention into the conventional classroom routine without highlighting it as an experimental or special activity.
3. Motivation and incentives should be given to the best Basic Science and Technology teachers on improvisation of instructional materials in their respective schools by school administrators and government.
4. Expansion of the sampling scope should be considered for greater generalizability in the future related studies.
5. Longitudinal studies should be carried out to assess sustained impact of improvisation of instructional materials on students' attitudes in Basic Science and Technology in Lagos State Schools.
6. The cost-effectiveness and scalability of improvisation should be explored in the future related studies within Lagos state schools and beyond.
7. Modern tools and equipment for the improvisation of Instructional materials should be provided to all Upper Basic Education level schools in Lagos State.
8. Intra- and Inter-school competition on Improvisation of instructional materials should be encouraged in all Lagos state Upper Basic schools.
9. All Basic Science and Technology teachers in Lagos state should be trained and retrained periodically on improvisation of Instructional materials.
10. Oral interview should also be used together with questionnaires in future studies for those students who have hand impairment or difficulty in writing to contribute their responses on the students' attitudes towards improvisation of instructional materials in Basic Science and Technology in some Lagos State Upper Basic Schools.
11. Research should also extend to the assessment of Teachers' improvisation of Instructional materials in Lagos state Secondary schools.

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