EXPLORING THE PERCEIVED INFLUENCE OF IMPROVISED CONSUMABLE CHEMICAL SUBSTANCE IN INSTRUCTIONAL DELIVERY ON STUDENTS' INTEREST IN LEARNING CHEMISTRY

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ABSTRACT

The study investigated the perceived influence of improvised consumable chemical substance in instructional delivery on students' interest in learning chemistry. A survey design was adopted for the study. The population of the study comprised of nine hundred and seventy-four (974) SSII chemistry students in Awka South L.G.A, Anambra State. The stratified random sampling technique was used to select one hundred and fifty-nine (159) SSII chemistry students from the population as the sample. Four research questions and one null hypothesis tested at 0.05 level of significance guided the study. The reliability coefficient of the instrument was established using Cronbach- Alpha Method and it was 0.83. Four-point scaled structured questionnaire of 34 items was used as instrument for data collection. Mean and standard deviation were used for data analysis while the null hypothesis was tested using z-test statistical tool. Findings from the study revealed amongst other things that improvised consumable chemical substances can aid bridge resource gaps in underfunded schools and provide equal learning opportunities and passion thereby encouraging creativity and innovation among students, fostering a deeper interest in the subject. Improvisation activities should be integrated into the chemistry curriculum to enhance hands-on learning experiences and promote critical thinking skills. It was also discovered that improvised chemical consumable substances influenced more female students' interest than male student's interest in learning chemistry. Null hypothesis revealed that there is no significant difference between the male and female students on the influence of improvised consumables chemical substance in instructional delivery on students' interest in chemistry. Based on the findings, recommendations were however made.

Keywords: Exploring, Perceived, Influence, Improvised, Consumable, Chemical, Substance, Instructional, Delivery, Students, Interest, Learning, Chemistry

Introduction

Science education could be recognized worldwide as a pre-requisite to technological advancement and involves the study of an in-depth science and in addition, educational knowledge and concepts (Pember & Humbe, 2019). Science education could be viewed as a process of teaching or training especially, within the school system to improve one's knowledge about the environment and to develop one's skill of systematic enquiry as well as natural attitudinal

characteristics (Olalekan & Omosewo 2018). This goal of science education cannot be achieved without chemistry playing a central role. Chemistry has been identified as a very important subject and its importance in scientific and technological development of any nation has been widely reported. It was as a result of the recognition given to chemistry in the development of the individual and the nation that it was made a core subject among the natural science and other science related courses in Nigeria education system. Nnoli (2023) asserts that chemistry integrates physical, biological and applied sciences, enabling students.to learn the scientific method and develop critical thinking, deductive reasoning, problem-solving and communication skills. To understand the concepts, material substances studied in chemistry are made to interact during practical or experimental work to bring their properties, thus, justifying Chemistry as an experimental science that relies primarily on practical work (Okafor, 2019). Practical works enhance students' motivation, interest, and understanding of chemistry concepts (Osigwe, 2023). It also enhances students to acquire relevant science process skills like observation, problem-solving as well as scientific interpretation skills. To foster interest among learners, there is need for the use of improvised instructional materials.

Onuh (2022) sees improvisation as the act of using alternative materials and resources to facilitate instructions whenever there is lack or shortage of specific first hand teaching aids. Akusoba (2023) added that there are various methods used to increase class participation and performance among students and improvisation of instructional teaching materials is one of them. To make learning more meaningful, lively, understandable and real, appropriate instructional methods must be applied (Ilarbor & Chukurdi, 2018). Improvisation enables students to connect abstract concepts taught, to real life experiences known to them and encourages them towards the

development of creative abilities, strengthens enquiry, discovery and investigative methods in science (Nnoli, 2021). Improvisation in general aids instructional delivery.

Instructional delivery refers to the methods and strategies that teachers use to convey content and engage students in the learning process. It is a critical aspect of education as it determines how effectively students understand and retain information (Okafor, 2019). Teachers employ various techniques, such as lectures, demonstrations, discussions, and multimedia tools, to deliver content in a way that meets the diverse needs of learners. One key element of instructional delivery is clarity in presenting information. Teachers must structure their lessons in a coherent and organized manner, ensuring that students can follow the flow of ideas. Practical chemistry is the experimental method of teaching chemistry and it is always conducted with chemicals and equipment. Practical chemistry helps to consolidate conceptual understanding of chemistry as a subject. It is not just a subject that can only be taught by theory lessons but a partner in the development of concepts and understanding (Okereke & Jibola, 2019).

The practical work helps to inculcate in the students the desired science process skills and attitude needed for problem solving. Practical science lessons help students to investigate problems, internalize scientific methods and develop in them the ability to manipulate apparatus. These accrued benefits cannot be possible in the absence of consumable chemical substances for demonstrations and practical lessons.

Consumable chemical substances refers to the chemicals used in classroom experiments and demonstrations. These substances can include common reagents like acids, bases, salts, and organic compounds used in practical chemistry lessons. When students actively participate in experiments, their curiosity **and** interest in the subject can increase, leading to a deeper

understanding and appreciation of chemistry (Okereke & Jibola, 2019). For instance, simple experiments with household chemicals like vinegar (acetic acid) and baking soda (sodium bicarbonate) to demonstrate chemical reactions can make abstract concepts more concrete and relatable. More advanced demonstrations might use substances like copper tetraoxosulphate vi acid for electroplating or sodium thiosulfate for studing reaction rate.

Practical chemistry lessons/activities demand various chemicals and equipment and some of the laboratory equipment and chemicals are often inadequate in schools. Musa (2019) supported this view and opined that schools in developing countries, of which Nigeria is one, often lack basic facilities, which are indispensable for teaching and learning of chemistry concepts as well as development of students' interest in the subject. Chemistry teaching in many schools has been severely threatened by lack of funds, inability of the teachers to improvise, careless attitudes of students to laboratory facilities, lack of laboratory assistants, large practical classes and teachers' preference to verbal instructions and board notes (Ogbodo, 2020).

The term interest refers to a psychological state of getting an effective reaction to any topic of focus. At the same time, it deals with engaging and re-engaging with the same ideas, objects, or events. Students' interest can also be seen as the inclination of the student towards a particular subject in which he or she is easily to connect without any difficulty.

Osuagwu (2020) explained interest as a psychological state of engagement, experienced in the moment, and also a predisposition to engage repeatedly in particular ideas, events, or objects over time. Interest promotes comprehension and memory for several reasons: interest increases attention to a text; interest makes people process a text more deeply; and interest promotes good meta- cognitive strategies.

Gender refers to the roles, behaviors, activities, expectations, and societal norms associated with being male or female. It is a social and cultural construct distinct from biological sex, which is based on physical characteristics. Studies, such as those by Obidimma & Osuafor (2019), have found no significant gender differences in academic achievement when students are taught with improvised consumable chemical substances. This suggests that both male and female students benefit equally from such instructional methods in terms of performance.

Shortage of chemical consumables among others in the teaching of science in schools is not a novel issue (Edidiong, 2019). This is in line with Musa (2022) and John (2023) who agreed that educational chemical consumables and equipped laboratories are lacking in schools. Onuh (2022) is of the opinion that the use of practical lessons to facilitate teaching and learning of science subjects should be a welcome development. This is in conformity with Dike (2023) who asserts that science teachers should work beyond stereotyped science teaching-learning process and utilize the available materials in the environment to facilitate science teaching- learning process. Therefore for effective teaching of science subjects like chemistry, the use of improvised chemical consumables is vital because it enhances instruction.

Statement of problem

It is the responsibility of every teacher to realize the effect of chemical consumables in teaching. More so, research reports have shown that these required consumables are highly unavailable in most schools and the available ones are either inadequate or underutilized. Because of the practical nature of chemistry, its teaching and learning could not be effective without adequate and relevant use of these chemical consumables (Osigwe, 2023). This is the reason many teachers cite the unavailability of these chemical consumables as the reasons for not exposing students to the practical aspects of chemistry. There is also the problem of unavailability and under-

utilization of these chemicals because of the financial implications or lack of teachers' manipulative skills on the use of these resources. This made the subject very difficult to learn and consequently, the poor performance of students recorded in examinations revealing students' poor interest in the subject. This study is hence propelled to investigating the perceived influence of improvised consumable chemical substance in instructional delivery on secondary school students' interest and in learning chemistry.

Purpose of the Study

The main purpose of this study is to investigate the perceived influence of improvised consumable chemical substances in instructional delivery on secondary school students' academic achievement in chemistry. Specifically, the study seeks to determine the:

1. Perceived influence of improvised chemical consumables on students' interest in learning chemistry.
2. Perceived challenges facing the improvisation of chemical consumables.
3. Perceived strategies to curbing the challenges facing the improvisation of chemical consumable substances.
4. Gender difference on the perceived influence of improvised consumable chemical substances on students' interest in learning chemistry.

Research Questions

The following research questions are formulated to guide the study:

1. What is the perceived influence of improvised chemical consumables on students' interest in learning chemistry?

2. What are the perceived challenges facing the improvisation of chemical consumables?
3. What are the perceived strategies to curbing the challenges facing the improvisation of chemical consumable substances?
4. What are the gender difference on the perceived influence of improvised consumable chemical substances on students' interest in learning chemistry?

Research Hypothesis

HO_1: There is no significant difference between the male and female students on the perceived influence of improvised chemical consumables on students' interest in chemistry.

Methods

A descriptive survey research design was adopted for this study. The study was carried out in all senior secondary schools in Awka South Local Government Area of Anambra State. The population of the study comprised of nine hundred and seventy-four (974); (588 females and 386 males) SSII students from all the nineteen (19) senior secondary schools in Awka South Local Government Area, Anambra State. The sampled for the study was 159 SSII Chemistry students in senior secondary schools in Awka South L.G.A, Anambra state using stratified random sampling. Eighty-three (83) female students and seventy-five (76) male students were randomly selected. The instrument used for data collection was a 34 items structured questionnaire which was designed based on the research. Questions guiding the study. The questionnaire was divided into two parts. Part A, was for demographic and personal information of the categories of respondents, while Part B, was for the research questions items. The draft copies of the questionnaire including the purpose of the study and the research questions were validated by three experts in the

department of Science Education, and Educational foundation, Nnamdi Azikiwe University, Awka. This validation was to ensure that face and content validity of the research instrument were established. Their contributions were duly incorporated in producing the final copies that were distributed to the respondents. The reliability coefficient of 0.83 was established using Cronbach-Alpha Method. 156 copies of the research instrument (questionnaire) were administered to the respondents by the researcher. The respondents filled the questionnaires and the researcher collected the same on the spot, on different scheduled days, to ensure 100% return. A total of 159 copies of the questionnaire were distributed and collected. Both descriptive and inferential statistics were used to analyze the data of this study. The descriptive statistical tool of mean was used to analyze the research questions while the inferential statistical tool of z-test was used to analyze the research hypothesis of the study at 0.05 level of significance. The items were placed on a four-point scale. Any response having a mean rating of 2.50 and above is accepted, while any response with a mean rating below 2.50 is not accepted. As for the hypothesis, if the value of z-crit at 0.05 level of significance is less than the z-cal value, the null hypothesis is rejected. However, if the value of t-crit at 0.05 level of significance is more than the z-cal value, the null hypothesis is accepted.

Research Question One: What is the perceived influence of improvised chemistry consumables on students' interest in chemistry?

Table 1: Mean Responses on the Influence of Improvised Chemistry Consumables on Students' Interest in Chemistry

S/N	ITEMS	X	S.D	REMARKS
1	Improvised chemical consumables make learning more engaging, thereby increasing students' interest in chemistry.	3.21	0.68	Accepted
2	It makes abstract concepts more concrete, increasing curiosity, aiding in better understanding and retention of knowledge.	3.18	0.90	Accepted
3	Using improvised materials can enhance students' problem-solving skills as they learn to apply concepts and engage in practical scenarios.	3.01	0.93	Accepted
4	These materials are not always accessible and affordable, allowing for more frequent and hands-on experiments.	1.95	0.93	Not Accepted
5	They can help bridge resource gaps in underfunded schools, providing equal learning opportunities and passion.	3.19	0.69	Accepted
6	The process of preparation of improvised materials is tedious and cumbersome.	1.81	0.79	Not Accepted
7	Improvised consumables encourage creativity and innovation among students, fostering a deeper interest in the subject.	3.33	0.99	Accepted
8	They can make chemistry lessons more fun and interactive, reducing the intimidation some students feel towards the subject.	3.20	0.70	Accepted
9	Students tend to perform better in assessments when they have hands-on experience with the concepts being tested through engagement and curiosity.	3.00	0.96	Accepted
10	They cause distraction on the students.	1.95	0.89	Not Accepted
11	The use of everyday materials can demystify chemistry, making it seem more relevant and applicable to daily life.	3.20	0.70	Accepted
12	The use of improvised chemical consumables can lead to inaccurate or unreliable results in experiments.	2.12	1.11	Not Accepted

From Table 1, items 1, 2, 3, 5, 7, 8, 9, and 11 were accepted as they had mean scores above the cut-off point. Items 4, 6, 10, and 12 were not accepted.

Research Question Two: What are the perceived challenges facing the improvisation of chemical consumables?

Table 2: Mean Responses on the Challenges Facing the Improvisation of Chemical Consumables

S/N	ITEMS	X	S.D	REMARKS
13	Improvised materials may not always meet standard safety regulations.	3.17	0.88	Accepted
14	The use of improvised chemical consumables may raise doubts in students about the outcome of an experiment.	3.20	0.74	Accepted
15	Improvised materials can sometimes produce inconsistent results, leading to confusion and inaccurate conclusions.	2.94	0.72	Accepted
16	Teachers may need additional training to confidently use and instruct with improvised consumables.	3.01	0.88	Accepted
17	There is often a lack of proper guidance on how to safely and effectively use improvised consumables.	2.71	1.42	Accepted
18	There can be a limited availability of certain everyday materials needed for effective improvisation.	3.18	0.75	Accepted
19	Some improvised materials may not be suitable for all types of experiments, limiting their use.	2.77	0.80	Accepted
20	Some materials for improvisation are expensive to acquire.	1.81	0.79	Not Accepted
21	Materials for improvisation are cheap and readily available.	1.71	0.85	Not Accepted
22	Ensuring the quality and reliability of improvised materials can be challenging, affecting the overall learning experience.	3.15	0.85	Accepted
23	The preparation and sourcing of these materials can be time-consuming for educators.	3.35	0.71	Accepted
24	Parents and school administrators might be sceptical about the efficacy and safety of improvised consumables.	3.03	0.99	Accepted

From table 2 above, the items 13, 14, 15, 16, 17, 18, 19, 22, 23 and 24 withthe mean scores of 3.17, 3.20, 2.94, 3.01, 2.71, 3.18, 2.77, 3.15, 3.35 and 3.03respectively were accepted by the respondents because they were above the cut- off point. Items 20 and 21 were below the cut-off point and were hence, not accepted. This indicates that Improvised materials may not always meet standard safety regulations.

Research Question Three: What are the perceived strategies for curbing the challenges facing the improvisation of chemical consumable substances?

Table 3: Mean Responses on perceived strategies for curbing the challenges facing the improvisation of chemical consumable.

S/N	Items	Mean ($\bar{X}$)	S.D	Remarks
25	Ministry of Education and other statutory bodies should offer training programs for teachers to learn how to create and use improvised chemical consumables.	3.19	0.64	Accepted
26	Funds should be secured from government and private partners to support improvisation efforts.	3.34	1.05	Accepted
27	Educational policies that encourage and standardize the use of improvised materials in chemistry laboratories should be developed.	2.92	1.01	Accepted
28	Improvised chemical consumables should be integrated into the chemistry curriculum for all students.	2.98	0.80	Accepted
29	Online platforms and local networks should be created for teachers to share resources and best practices.	3.02	1.05	Accepted
30	Research to be promoted to find effective and safe improvisation techniques and materials.	3.29	0.94	Accepted
31	The use of improvised chemical consumables by teachers should be discouraged.	1.64	1.10	**Not Accepted**
32	Regularly assess the impact of improvised materials on student learning and gather feedback from teachers.	3.21	0.69	Accepted
33	Foster a school culture that values creativity and practical application of scientific concepts.	3.37	0.79	Accepted
34	Recognize and reward teachers who successfully use improvisation in their teaching to inspire others.	3.18	0.75	Accepted

Table 3 shows that items 25, 26, 27, 28, 29, 30, 32, 33, and 34 had mean scores above the cut-off point of 2.50 and were therefore accepted. This implies that these strategies are viable for addressing the challenges faced in the improvisation of chemical consumable substances. However, item 31 was not accepted, indicating that discouraging the use of improvised chemical consumables is not a recommended strategy.

Research Question Four: What is the gender difference in the influence of improvised chemical consumable substances on students' interest in learning chemistry?

Table 4: Mean Responses of Male and Female Students on the Influence of Improvised Chemical Consumable Substances on Interest in Learning Chemistry

Gender	N	Mean ($\bar{X}$)	Standard Deviation (S.D)
Male	76	2.74	0.76
Female	83	2.94	0.59

Table 4 indicates that the mean scores for male and female students were 2.74 and 2.94, respectively. This indicated that improvised chemical consumable substances influenced more female students' interest than male in learning chemistry.

Hypothesis

Ho_1: There is no significant difference between male and female students regarding the influence of improvised chemical consumables on students' interest in chemistry.

Table 5: z-test Analysis of Mean Ratings of Male and Female Students on the Influence of Improvised Chemical Consumables on Students' Interest in Chemistry

Variables	N	Mean ($\bar{X}$)	Standard Deviation (SD)	Level of Significance	z-cal	z-crit	Decision
Male	76	2.74	0.76	0.05	-1.84	1.96	Accepted
Female	83	2.94	0.59				

Table 5 above indicated that the z-cal. was -1.84 and the z-crit. was 1.96 at 0.05 level of significance. Since the z-cal. is less than the z-crit., the null hypothesis that stated; there is no significant difference in the mean responses of male and female students on the influence of improvised chemical consumables on students' interest in chemistry, is hereby accepted.

Discussion

From table 1, it was found out that improvised chemical consumables make learning more engaging. It makes abstract concepts more concrete, increasing curiosity, aiding better understanding and retention of knowledge. Using improvised materials can enhance students' problem solving skills. This is in line with Jimoh (2020), who opined that the use of improvised consumable chemical substances encourages creativity and innovation in experimental design. Supporting the view above, Okpaleke (2021) argued that by exploring alternative materials and

methods, students may discover new ways to address scientific challenges, leading to novel insights and discoveries.

From table 2, it was deduced that improvised materials may not always meet standard safety regulations. The use of improvised chemical consumables may raise doubts in students about the outcome of an experiment, improvised materials can sometimes produce inconsistent results, leading to confusion and inaccurate conclusions (Adebimpe, 2019). The above findings supports the work of Okoye (2022) who opined that Attitude of some students who unwillingly prefers foreign materials to local ones may lose interest because of the locally improvised materials and so may not benefit from the lesson poses a challenge as such students even doubt the results derived using such materials.

From table 3, it was discovered that strategies to curbing the challenges facing the improvisation of chemical consumable substances include that the ministry of education and other statutory bodies should offer training programs for teachers to learn how to create and use improvised chemical consumables, secure funding government and private partners to support improvisation efforts. This is in line with Musa, (2020) who argued that Improvisation activities should be integrated into the chemistry curriculum to enhance hands-on learning experiences and promote critical thinking skills. In his opinion, Briggs (2022) advised Partnership with local businesses, community organizations, and government agencies to access surplus funds.

From table 4, it was discovered that improvised chemical consumable substances influenced more female students' interest than male in learning chemistry. This is in line with Adewele (2021) indicated that the use of improvised chemical materials in teaching chemistry

effectively enhances students' interest in the subject, regardless of their gender but in some cases female may be more beneficial than male.

From table 5, it was revealed that there is no significant difference between the male and female students on the influence of improvised chemical consumables on students' interest in chemistry. This is supported by findings from Adeoye (2021), which highlighted that both male and female students equally benefit from hands-on, practical chemistry activities using improvised resources, showing no statistically significant difference in interest between genders.

Conclusion

The findings of this study underscore the significant impact that improvised consumable chemical substances can have on enhancing students' interest and engagement in learning chemistry. The effective integration of these materials into the educational process is essential for making abstract concepts more tangible, fostering creativity, and promoting a deeper understanding of scientific principles. However, to fully realize these benefits, it is crucial to address the challenges associated with their use, such as ensuring safety, providing adequate teacher training and securing necessary resources. By implementing the recommendations provided, educational institutions can improve the quality of chemistry education, ultimately leading to better academic outcomes and a sustained interest in the sciences among students. Failure to act on these findings could result in missed opportunities for enhancing student learning, innovation and overall academic achievement.

Recommendations

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

1. Educational institutions should adopt the use of improvised consumable chemical substances within the chemistry curriculum to make learning more engaging and accessible, particularly in resource-limited settings.
2. Regular training programs should be organized for teachers to equip them with the skills needed to create and use improvised materials effectively and safely in the classroom.
3. Educational authorities should establish clear safety guidelines and standards for using improvised chemical materials in schools.
4. Schools should actively promote the use of improvised materials in a way that engages all students, regardless of gender. This approach will help to ensure that all students have equal opportunities to benefit from hands-on, practical chemistry activities.
5. Schools should seek funding from government agencies, private partners, and community organizations to support the use of improvised materials. Adequate resources will ensure that teachers have access to the necessary materials and that students receive a high-quality learning experience.
6. A school culture that values creativity and innovation should be fostered. Teachers who successfully implement improvisation in their teaching should be recognized and rewarded to encourage others to adopt similar practices.
7. Regular assessments should be conducted to evaluate the impact of using improvised materials on student learning outcomes. Feedback from teachers and students should be gathered to refine and improve the use of these materials over time.

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