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STRATEGIES FOR IMPROVING THE UTILIZATION OF ICT FACILITIES FOR TEACHING AND LEARNING CHEMISTRY IN SENIOR SECONDARY SCHOO IN UDI LGA.

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Abstract: A descriptive study investigated technology integration in teaching and learning of chemistry in Udi Local Government Area. Two research questions guided the study and were answered using the mean and standard deviation. Two hypotheses were tested using t-test statistics at the 0.05 level of significance. The study has a target population of 340 students. Its sample size consists of 184 respondents: ninety-seven males and eighty-seven females. The instrument for data collection which was structured by the researchers is known as technology integration in the teaching and learning of chemistry (TITLC). Cronbach alpha's formula was used to determine the reliability of the instrument, which has an index of 0.85 for TITLC. The results showed that all the identified strategies helped to improve the utilization of ICT facilities for the teaching and learning of chemistry in secondary schools. However, all the factors identified affect the use of ICT facilities. The result of the hypotheses showed that there was no significant difference in the mean rating of male and female students on strategies that help improve technology integration in chemistry. Lastly, there was no significant difference in the mean rating of male and female students among all the factors affect the use of ICT facilities .In accordance with the findings and conclusion of the study, the .recommendations were proffered among the other governments and institutions.

Keywords: Use of ICT, Teaching / Learning Chemistry.

Introduction

The study of chemistry instruction and learning is known as chemical education. It is a component of discipline-based education research (DBER), sometimes known as science, technology, engineering, and mathematics (STEM). Understanding how students learn chemistry and figuring out the best way to teach it are two themes related to chemistry education. The conclusions of research on chemistry education should be used to enhance chemistry curriculum and learning objectives. Chemistry teachers engage in training and capacity-building, as well as effective teaching strategies including lab exercises, lectures, and demonstrations in the classroom, to help improve chemistry education. Since human beings depend on the progression of chemical reactions with their bodies, the study of chemistry is vital to the world and subject to the law of chemistry everywhere. Studying science enables students to gain knowledge of scientific procedures as well as critical thinking, logical reasoning, problem-solving, and communication abilities. With its numerous transferrable abilities that can be applied to any field, teaching chemistry to kids also piques their interest in STEM careers (Chemical Universal Centre

Discipline-Based Education, 2012). According to Anon (2018), Technology has been in existence since the nineteenth century. Initially, gadgets like overhead projectors were considered significant advancements over older technologies like chalkboards, pencils, and ballpoint pens. According to Siwawetkul and Koraneeki (2018), the way technology can be used to support research has changed dramatically due to recent advancements in computing. Accessing information is now much simpler than it was with the introduction of the internet and smart gadgets. Pricahyo, Akhyar, and Suharno, (2018) contend that the way technology is used today in daily life makes information easier to get. The main issue is that educators must be motivated to investigate digital tools for chemistry instruction. Traditional teaching approaches are employed by chemistry teachers. Abualrob, (2019). in Voogt (2008) asserts that the primary deterrent to instructors using ICT tools pedagogically in the classroom is a lack of time to complete the educational plan.But since this is the first time they've used a range of tools, there might be some challenges, particularly if they have to work in groups on a project and learn how to present it in the classroom using technology. By integrating pedagogical learning technologies—which are essential to teacher preparation—the gaps in teacher preparation can be filled. Technology can help in the teaching and learning process, encourage student participation, and facilitate communication between teachers and students as well as between curriculum and students. It can also speed up the educational process. The Federal University of Rio de Janeiro offered creative teaching tools and methodologies for teaching chemistry as an online professional development course in order to overcome the challenges faced by chemistry teachers when utilizing learning technology. This was intended to be a continuing education program for Rio de Janeiro state chemistry teachers. In addition to thinking about the cultural, historical, social, methodological, and epistemological elements that are encountered during the teaching and learning process, the goal was to widen and develop the teaching knowledge and pedagogy when teaching chemistry. The use of learning technologies in the classroom and its significance are covered in the study, along with the possibilities of practicing the use of technology in the classroom. Information and communication technology (ICT) utilization, according to Zeba (2019), particularly the internet, has recently changed our ideas about traditional education, distance education learning, and the importance of life-long learning. This increases the amount of information available to the students as they learn their course and are employed for work. Students learn best by developing pre-existing knowledge, engaging in active learning, and embracing a meta-cognitive approach. According to Kevin (2014), social networking, texting, interactive gaming, online browsing, and other forms of technology use are all commonplace among both adults and children. In public schools, it's critical to include technology into instruction. Students' learning activities are positively impacted by technology. It gives them a meaningful learning experience, keeps pertinent knowledge in their memory, and engages them. In addition, it provides interactive educational exercises that may be included into the curriculum of any school, encompassing science, math, reading, social studies, and other disciplines. Students get the opportunity to work together and share knowledge with their peer group. In addition, technology permeates every aspect of daily life. Most of the tasks involved using technology. There are many ways that adults and students utilize technology to communicate and obtain information. According to Kenny (2011), elementary school students who use technological

tools develop competence and confidence in their computer skills as they get older. It also makes it possible for pupils to feel at ease utilizing computers in the classroom and fosters an engaging work atmosphere. As per Ryan, (2019).in Miller's (2011) findings, students who engage in activities they are enthusiastic about experience excitement and growth in their abilities and strengths. In addition to using technology to communicate, share ideas, and master their study, the learning is quick, motivating, and pertinent to integrate ICT in secondary schools in Nigeria. The Information Technology Policy of Nigeria (FRN 2012). Nigerian educators ought to be permitted to develop their capacity so they can become proficient in integrating and using technology for learning. Infrastructure required for the use of ICT in schools should be made available, schools ought to have the ICT resources required by the national IT policy. It should be possible to assist teachers in purchasing personal computers by providing loans. Tchameni (2018) in Arnseth and Hatlevik (2010) believed that teachers are responsible for integrating ICT into teaching and learning. The deployment of ICT in Nigerian schools must be overseen by a national organization. It is anticipated of such an entity to carry out research on ICT-related issues in schools and create ICT curricula for different educational levels, People use ICT according to their ICT literacy levels. According to Cantoni and Danowski (2015), is a means of obtaining, presenting, storing, and retrieving information via wireless networks, mobile devices, the internet, and other communication channels. Gilakjani (2017) defines technology integration as the expert application of the practical vocation of utilizing technologies in the classroom to effectively complete duties related to teaching and learning. Making kids ICT savvy and providing them with essential technology tools like computers, televisions, internet, mobile phones, radios, and interactive whiteboards are necessary to accomplish this. Their academic achievement will rise as a result. Yusuf and Josta (2019) cite Grabe and Grabe (2007) as saying that ICT is typically the knowledge transmission highway. Societies innovate through integrating various technology into various aspects of life, resulting in changes to the way people live, work, and think. Schools and other educational institutions must take responsibility for educating students to live in a knowledge-based society and for integrating ICT into teaching and learning, according to Ghavifekr, Afshari, and Amla (2012).Since the use of ICT tools in the classroom creates a dynamic and proactive learning environment and encourages students to learn by doing, . Yusuf and Josta (2019) in Khine (2006), observed that studies on ICT integration encourage student effort to control sensible learning when used as a medium of accessing knowledge, a tool of knowledge construction, learning by doing, and promoting thinking. Shine also emphasizes the use of ICT as a social tool to support cooperative learning and as a partner in knowledge to assist students in articulating their knowledge and learning processes. ICT offers benefits when it is included into teaching and learning, according to FissehaMikre (2011). It brings about changes in the areas of student-centered teaching and learning, communication and collaboration between teachers and students, and the exposure of students to real-world experiences and practical skills.ICT integration in chemistry education also gives instructors and students access to new knowledge sources and allows them to employ a variety of technologies in the classroom, which increases students' excitement for learning. It enables remote learning with the use of online learning materials to support the resource-based learning environment.

Ioanna. Nikiforos . Tassos (2018) noted that utilization of different digital platforms, tools, and

applications to improve the learning process is known as technology integration in chemistry education. These technologies enhance engagement, facilitate the practical application of theoretical knowledge, and simplify the explanation of difficult chemical ideas. Chemistry education has been revolutionized by technologies including data analysis software, multimedia tools, virtual labs, and simulations. Students can interact with 3D molecular models, chemical structures, and reactions in an immersive and engaging manner by utilizing Virtual Reality (VR) and Augmented Reality (AR). With the help of these tools, students can safely investigate risky or resource-intensive experiments, watch chemical reactions, and control molecules in a virtual environment. Moreover, AR tools can overlay molecular structures in actual environments, giving abstract ideas greater tangibility. A crucial part of teaching chemistry is using digital simulations, which let students carry out virtual experiments that mimic actual chemical reactions. Students can conduct experiments in virtual labs without the need for real lab supplies or concern about safety hazards thanks to platforms like Labster and Chem Collective. These resources are especially helpful for distant or remote learners who might not have access to actual laboratories. Chemistry can be made more interesting by using interactive films, animations, and tests. Multimedia tools make complex subjects like thermodynamics, stoichiometry, and reaction mechanisms easier for students to understand by offering concise, visual explanations. High-quality educational resources are available on websites like Coursera, Khan Academy, and YouTube, allowing students to study at their own speed.

Gender has been identify as a critical factor that affect competencies and attitudes towards instructional technology Atimi, Afandi, & Tenriawaru, (2023) in (Maduekwe,2006) .He found that females have lower score on competencies for using instructional technology than their male counterparts. In a different opinion. Nwachukwu and Njoku (2021) in Okafor (2010) states that females are more innovative in the use of instructional technology than male **Joanna., Nikiforos Tassos** stressed that In today's classroom, teamwork is crucial. Students and teachers can communicate and work together more easily when they use tools like Zoom, Microsoft Teams, and Google Docs. By making it simpler to plan group projects, participate in peer conversations, and exchange materials, these technologies promote a connected and cooperative learning environment. Chemistry students' motivation and retention can be increased through gamification. Difficult subjects like chemistry are made more approachable and enjoyable by apps and games like Chem Collective and ChemCaper, which transform learning chemistry into interactive challenges or puzzles. These applications help kids learn through play by reinforcing important chemistry ideas through scenarios that resemble games. Although using technology into chemistry teaching has many benefits, there are drawbacks as well. Teachers' preparedness is a big problem since they might not have received enough training to use digital tools like virtual laboratories and simulations efficiently. The "digital divide" is a result of the fact that not all students have equal access to devices or dependable internet connections, this brings up another issue of accessing It.

Purpose of the study are to:

(1) Determine the strategies to improve the utilization of ICT facilities for the teaching and learning of chemistry in Udi LGA.

(2) Determine factors that militate against utilization of ICT facilities for teaching and learning of chemistry in Udi LGA.

Research Questions

The following research questions guided the study:

(1) To what extent do these strategies improve the utilization of ICT facilities for teaching and learning of chemistry in secondary school?

(2) What factors militate against utilization of ICT facilities for teaching and learning of chemistry in secondary school?

Hypotheses

The following two null hypotheses guide the study at 0.05 level of significant.

(1) There is no significant difference in the mean score between male and female student's responses to the strategies to improve the utilization of ICT facilities for the teaching and learning of chemistry in senior secondary school.

(2) There is no significant difference in the mean score between male and female responses to factors militating against the utilization of ICT facilities for the teaching and learning of chemistry in secondary school.

Methodology,

The study employed a descriptive survey design, which involves the collection of information from a sample of the population through their responses to questions (Ali 2006, Enyi , &Ikenazor 2023). The study was carried out in udi local government area in Enugu State, which is located in the south-east of Nigeria. The population of the study consists of 340 students.

Sample size: One hundred and eighty-four (184) questionnaires were distributed by the researcher. The same numbers were returned. Therefore, the sample size is 184. Sample proportion of the population was calculated using kumar's manual of sampling technique which has formula

$$n = \frac{N}{I + N(e)^2}$$

Instrument for data collection the instrument was developed from data collection in the study, namely the Technology Integration in Teaching and Learning of Chemistry in Secondary Schools in the Udi Local Government Area of Enugu State questionnaire. (TITLCSS) .The research use response as very large extent (VLE), large extent (LE), moderate extent (ME), small extent (SE), and very small extent (VSE).to question number one while question number two Strongly agree(SA), Agree(A),, Disagree(D), Strongly disagree (SD) for question number2

Validation and reliability of the instrument.

The instrument was validated by three experts, one from measurement and evaluation and two from science education, all from the University of Nigeria, Nsukka. Cronbach's alpha formula was used to determine the reliability of the instrument. An internal consistency reliability of 0.95 was determined for the overall instrument

Method of Data Collection

The data was collected with the help of research assistance, arranged in tabular form and analyzed using the mean and standard deviation. In the analysis, values questions were arranged in such a way as to look for specific information, and the analysis was made in that order.

Method of Data Analysis

Research questions were answered using the mean and standard deviation, while a t-test at the 0.5 level of significance was used in testing the null hypotheses. A criteria mean of 3.00 was used as the bench mark. Any item whose response has a mean score of 3.00 or above will be accepted, while those below will be rejected.

Research Question 1

To what extent do these strategies improve the utilization of ICT facilities for the teaching and learning of chemistry in smart green schools initiative in senior secondary schools in Udi LGA?

Table 1: Strategies to improve the utilization of ICT facilities for teaching and learning chemistry in senior secondary schools in Udi LGA.

S/NO	Questionnaire items	VERY Large extent	Large extent	Moderate extent	Small extent	Very small extent	Mean	Standard deviation	Remarks
1	Regular training and retraining of staff and students on awareness and used of ICT facilities for teaching and learning purpose	50	48	46	21	19	3.48	1.2	moderate extent
2	Ability to provide alternative source of power for ICT facilities.	55	51	42	11	25	3.54	1.3	moderate extent
3	Effective management and maintenance of the available ICT facilities.	49	43	42	26	24	3.34	1.3	moderate extent
4	Government increase of funding of ICT facilities in schools.	45	53	41	25	20	3.41	1.2	moderate extent
5	Sustainable partnership between government, private sector and NGO's in procurement of the ICT facilities.	49	34	55	24	22	3.40	1.3	moderate extent
6	Use of internally generated revenues by administrations of school to provide ICT facilities.	44	38	51	27	24	3.27	1.3	moderate extent
7	Institution collaborating with professional and corporate bodies for technical support	48	46	45	15	30	3.36	1.3	moderate extent

8	Encourage and supporting teachers to own a pc or a laptop.	42	47	46	28	21	3.3	1.2	moderate extent
9	Employ staff by merit	24	27	30	55	59	2.25	1.3	small extent
	GRAND MEAN						3 .3	1.2	

Data in Table 1 showed that the respondents, 184 students, had a mean rating score ranging from 3.25 to 3.54 with a grand mean of 3.30 and a standard deviation of 1.2. It was only in item 9 (employ staff by merit) that the respondents gave a mean score of 2.25, which is below the criterion mean score of 3.00; therefore, the respondents showed that it was not among the strategies that help to improve the utilization of ICT facilities for teaching and learning chemistry in senior secondary school. In all the rest of the identified items, the respondent had mean ratings that were greater than the criterion mean, showing that students need all the identified teaching strategies that help to improve the utilization of ICT facilities for teaching and learning chemistry in senior secondary school.

HYPOTHESIS 1

There is no significant difference in the mean score between male and female students' responses to the strategies to improve the utilization of ICT facilities for the teaching and learning of chemistry in senior secondary school.

Table 2: Summary of t-test Analysis on the mean rating scores of male and female students responses on the strategies that improve the utilization of ICT facilities for teaching and learning of chemistry

Variables	**n**	**$\bar{X}$**	**SD**	**df**	**Tcal**	**Sig.**	**Dec**
Male	97	2.94	1.27				
				182	-1.913	.912	NS
Female	87	3,30	1.28				

Key: N = Sample Size, $\bar{X}$ = Mean, S = Standard Deviation, df = Degree of freedom, Dec = Decision, NS = Not Significant

Data in Table 2 showed that an independent-sample t-test was conducted to test the mean rating of male and female students' responses to strategies that help improve the utilization of ICT facilities for the teaching and learning of chemistry. The mean and standard deviation, as shown in the table, are male (=2.94, SD = 1.27), and female (=3.30, SD =1.28). From the result of the t-test, it was found that the calculated value (-1.913) is less than the tabulated value (1.660). Therefore, we fail to reject the null hypothesis that there is no significant difference in the mean score of male and female students on teaching strategies that improve the utilization of ICT facilities for the teaching and learning of chemistry

RESEARCH QUESTION 2

What are factors militate against the utilization of ICT facilities for the teaching and learning of chemistry in secondary school?

Table 3 factors militate against the utilization of ICT facilities for the teaching and learning of chemistry in secondary schools

Items descriptions	**Strongl**	**Agree**	**Disagree**	**Strongl**	**Mean**	**Std**	Remar

		y Agree			**yDisagree**			ks
1	Insufficient interconnectivity of internet service to sport ict facilities teaching.	54	58	50	22	2.78	**1.0**	accepted
2	Lack of trained personnel	55	52	50	22	2.77	**1.0**	accepted
3	Scarcity of ict facilities	57	52	50	25	2.76	1.0	accepted
4	High cost of acquisition of ict facilities and maintenances	55	50	54	25	2.73	1.0	accepted
5	Poor administration supervision of programmes	52	51	53	28	2.69	1.1	accepted
6	Dearth of fund	57	56	52	29	2.82	**1.0**	accepted
7	Irregular supply of electricity	53	52	50	29	2.70	**1.1**	accepted
8	Lack of access to ict facilities	52	51	49	32	2.66	1.1	accepted
9	Traditional mentality of some computer education	49	50	50	35	2.61	**1.1**	accepted
10	Lack of dynamism of shift from old to new instructional delivery system using ict facilities	**28**	30	32	64	2.10	1.0	accepted
	GRAND MEAN					2.66	1.0	

Data in Table 2 showed that the respondents, 184 students, had a mean rating score ranging from 2.82 to 2.61 with a grand mean of 2.66 and a standard deviation of 1.0. It was only in item 10 (lack of dynamism in the shift from an old to a new instructional delivery system using ICT facilities) that the respondents gave a gave a mean score of 2.10, which is below the criterion mean score of 2.50c; therefore, the respondents showed that it was not among the factors militating against the utilization of ICT facilities for teaching and learning chemistry in secondary school. In all the rest of the

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identified items, the respondent had mean ratings that were greater than the criterion mean, showing that students do not need all the identified factors to militate against the utilization of ICT facilities for the teaching and learning of chemistry in secondary school. The opinion of the respondent indicates that these factors affect the use of ICT facilities for the teaching and learning of chemistry in senior secondary school.

Hypothesis (2)

There is no significant difference in the mean score between male and female student's response to factors militating against the utilization of ICT facilities for the teaching and learning of chemistry in secondary school.

Table 4: Summary of a t-test analysis on the mean rating scores of male and female students response to factors militating against the utilization of ICT facilities for the teaching and learning of chemistry in secondary school.

Variables	N	$\bar{x}$	SD	df	tcal	Sig.	Dec
Male	97	3.39	1.25				
				182	.988	.925	NS
Female	87	3.20	1.28				

Key: N = Sample Size, $\bar{x}$ = Mean, S = Standard Deviation, df = Degree of freedom, Dec = Decision, NS = Not Significant

Data in Table 4 shows that an independent-sample t-test was conducted to test the mean ratings of male and female students on factors militating against the utilization of ICT facilities for the teaching and learning of chemistry in secondary school. The mean and standard deviation, as shown, are males (= 3.39, SD = 1.25) and females (= 2.30, SD = 1.28). From the result of the t-tests, it was found that the calculated value was.988 less than the tabulated value (1.660). The null hypothesis was therefore not rejected. This indicates that there was no significant difference in the mean rating of male and female students on all the identified factors militating against the utilization of ICT facilities for the teaching and learning of chemistry in secondary school.

Discussion

The findings of the study showed that the students need all the identified strategies that improve the utilization of ICT facilities for the teaching and learning of chemistry in senior secondary school. Technology has completely changed education and our society. Wireless internet access, interactive whiteboards, graphing calculators, laptop computers, tablets, and other evolving technologies are among the devices available to use in the chemistry classroom. These tools can enhance student-centered instruction if utilized appropriately. In accordance

with Ioanna . Nikiforos_and Tassos M (20.18) educational technologies were employed in the teaching of chemistry because of their main features, such as arousing student interest, giving teaching opportunities, and monitoring learning activities. This is in collaboration with FissehaMikre (2011). ICT integration in chemistry teaching enables teachers and students to access new sources of information and use many technologies in teaching, thereby building greater learning enthusiasm among students. It permits distance learning with online educational resources to help in the resource-based learning environment. The findings of the study show that students identified all the factors militating against utilization of ICT facilities for teaching and learning of chemistry in secondary school. Lack of trained personnel, dearth of fund, High cost of acquisition of ict facilities and maintenances, poor administration and supervision of the programme. Chemistry teachers in Nigerian should be allowed for capacity building to enable them be capable in the use and integration for instructional purposes. There should be provision of infrastructure needed for implementation of ICT in school. This in line with the Nigerian policy for information technology (FRN 2004) school should be equipped with necessary ICT facilities as envisage in the national it policy. Teachers should be helped to acquire personal computer through loans as obtained in other countries.it is necessary for a national agency to be in charge of ICT implementation in Nigerian schools. Such an agency is expected to conduct research into ICT issues in schools and develop curriculum on ICT for various levels of education. This is also in accordance with Arnseth and Hatlevik's (2010) opinion that teachers are responsible for ICT integration in teaching and learning since the use of ICT tools in the classroom creates dynamic and proactive teaching and an environment that enhances learning. Conclusion: The incorporation of technology into chemistry instruction substantially improves the educational process by bringing abstract ideas to life, encouraging teamwork, and raising student interest. However, addressing the obstacles pertaining to teacher preparation and resource accessibility is essential for the successful adoption of these technologies. The impact of educational technologies on chemistry education is expected to increase as they evolve, making instruction more dynamic and efficient. The novelty of technology pose challenges to teachers and motivate the learners, this call for the training of teachers. The use of modern facilities in educating students will draw out the best in every students. Technology integration increased collaboration in student, motivation, student engagement, confidence in students, allows students to learning at all levels; and increased technology skills.

Recommendation Use virtual labs and interactive simulations help students visualize abstract chemical concepts and carry out experiments in a safe virtual setting. The following recommendations were made based on the findings.

- Government should endeavor to recruit qualify chemistry teachers with knowledgeable ICT experience.
- Communities need to assist Government in providing computer facilities in school for efficient and effective teaching and learning.
- Government should be organizing capacity building for secondary school teachers to update their knowledge on new trend of technology...

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