E-ISSN: 1116 - 3240 P-ISSN: 3026-9334
MPRI-JAIMR | INTERNATIONAL JOURNAL OF AFRICAN INNOVATION & MULTIDSCIPLINARY RES.
VOL. 03 NO. 2 – JANUARY, 2024

A COMPARATIVE STUDY OF INFORMATION AND COMMUNICATION TECHNOLOGY (ICT-BASED) AND CONVENTIONAL METHODS OF INSTRUCTION ON LEARNERS' ACADEMIC ENTHUSIASM FOR JUNIOR SECONDARY LEARNING

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Abstract

The present study aimed to compare the effects of information and communication technology (ICT)-based and conventional methods of instruction on ninth-grade students' academic enthusiasm for junior secondary learning (English). The statistical population included all ninth-grade students from lower secondary schools located in Jalingo, Taraba State, Nigeria, in 2021–2022. For this purpose, applied research with a quasi-experimental design was employed to meet the study objectives. To select the statistical sample, the convenience sampling method was used, so one school equipped with the essential facilities was chosen to implement the ICT-based education. Then, two classrooms at the given school were selected as the experimental and control groups, each one consisting of 27 students, based on the random sampling method. The research tool was the 15-item Academic Enthusiasm Questionnaire (AEQ) containing behavioral, emotional, and cognitive subscales, and recruiting a five-point Likert-type scale.

Keywords: ICT-Based Instruction, Conventional Instruction, English Language, Academic Enthusiasm, Junior Secondary Learners.

All the classrooms initially received a pretest, and then the experimental group was instructed by the ICT-based education. Finally, all the study groups completed a posttest. Moreover, inferential and descriptive statistics were applied for data analysis. The study results demonstrated a significant difference in terms of the baseline academic enthusiasm between the experimental and control groups. In addition, the ICT-based method of instruction showed stronger effects on students' academic enthusiasm than the conventional one.

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Introduction

It is widely accepted that the information and communication technology (ICT)-based method of instruction is one of the main processes of teaching and learning of junior secondary learning (English) because it adds vitality to the classroom contexts like those in virtual settings. In fact, researchers have not reflected on ICT as a single technology but rather one of the combinations of software, hardware, delivery systems, as well as multimedia. In current education systems, ICT involves numerous rapidly emerging technologies, such as notebook, handheld, and desktop computers, the Internet, digital cameras, the World Wide Web (WWW), cloud computing, tutorials, spreadsheets, emails, simulations, Bluetooth, local area network (LAD), digital versatile discs (DVDs), and streaming, together with applications, such as virtual environments, word processors, digital libraries, teachers and students can have easy access to the study and course materials from all situations at all times (Abdalqader, Ariffin, Ghazi, Baobaid & Fadzil, 2018; Akbay & Delibalta, 2020; Ardıç & Çiftçi, 2019).

According to the related literature, advancements in ICT are among the crucial issues to meet the needs of education systems (see Adinda, Parta & Chandra, 2021; Ahmed & Al-Kadi, 2021; Chao 2015). For Oduma and Ile (2014), ICT has been also introduced as one of the tools supporting learning processes and holding the promises of new solutions to the challenges facing education systems. Hence, there are positive prospects for ICT in English classrooms, whose success largely depends on several factors, such as teachers' and students' attitudes toward the role of ICT in the teaching and learning process of English as well as their perceptions of ICT skills (Antelm, Gil, Gonzalez, Perez & Pedrero, 2020; Das, 2019; Davoudi, Fartash, Zakirova, 2018). Multiple publications have thus far verified the benefits of ICT use for educational goals (Alonso-Garc´ıa, Aznar-D´ıaz, Caceres-Reche, Trujillo-Torres & Romero-Rodr´ıguez, 2019; Fernandes, Rodrigues, & Ferreira, 2018; Ghory & Ghafory, 2021), as it offers some tools for scalable, student-adopted mobile teaching solutions and online teaching (Ahmad, Hoda & Alahmari (2020). Additionally, integrating ICT into the teaching process can be generally amplified by incorporating digital resources and respective methodologies (Prendes-Espinosa, Garc´ıa-Tudela, & Solano-Fern´andez, 2020).

The utilization of ICT by English teachers represents their positive attitudes toward technology as well as the application of compatible teaching methods for their implementation inside and outside classrooms (Fredricks, Blumenfeld & Paris, 2004; Griffith, Hagan, Heymann, Heflin, & Bagner, 2020; Mosteanu 2021). Moreover, in the case of the suitable use of the related technologies, tasks are considerably simplified, collaborative work is promoted (Dalby, 2019; Gunasinghe, Hamid, Khatibi & Azam, 2018), and students' learning is motivated (Andersen, Beuchert, Nielsen & Thomsen, 2020; Gunasinghe, Hamid, Khatibi & Azam, 2019; Mikropoulos, 2018). The positive effects of ICT can be further observed in students' academic performance (Alemayehu & Natarajan, 2018; Guillen-G ´ amez & Mayorga-Fern ´ andez, 2020).

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However, some doubts have been raised on the appropriate use of ICT by teachers because of initial indifference and reluctance, as well as the absence of certain teaching methods (Chen, Gamble, Lee & Fu, 2020; Fartash, Davoudi & Baklashova 2018; Kayha & Hoveyda, 2013; Mercader, 2020). Thus, conventional methods of instruction no longer meet the growing demands for education, and e-literacy is a way to move through the information society (Kozakli & Yazgan, 2021; Pinxten, Wouters, Preckel, Niepel, De-Fraine & Verschueren, 2015; Souvannasouk, Shen, Trejo & Bhuyar, 2021).

According to Jennifer (2015), academic enthusiasm also plays a leading role in academic achievement, promoting students' education and reducing risky behaviors at schools. This is because it increases their commitment to educational goals and involvement in relevant assignments (Bashpour, Isazadegan, Babalan & Ahmadian 2013; Nazari 2021; Nicolete, Bilessimo, Cristiano, Simão & da-Silva, 2017). Academic enthusiasm here refers to the amount of energy that students spend doing their academic work as well as the effectiveness and efficiency achieved (Naiami & Piriyah, 2012; Semiz & Baykal, 2020). Academic enthusiasm can thus lead to effective participation in school and classroom activities, adaptation to school culture, and good relationships with teachers and other students (Cadima, Doumen, Verschueren, & Buyse, 2015; Olga & Annika, 2020; Pehlivan & Koseoglu, 2012).

Researchers, including Allah Karami and Manoochehri (2014) and Sattari, Namvar, and Haj Nazari (2012) similarly analyzed the effects of ICT on students' success. Interaction, cooperation, discipline, and interest have accordingly increased creative thinking, desire for the classroom, doing homework, and discipline in students. Kayha and Hoveyda (2013) also examined the impact of ICT on the learning process in lower secondary school students in the city of Zahedan, Iran, and showed the positive effect of ICT in boosting students' perseverance, creativity, and academic success. Moreover, male and female students were in different grades.

Brain, Wood, Tsukayama, Har, Chiu and Langer (2014) in their study aimed at analyzing the relationships between academic achievement, academic self-simulators, emulators, video-conferencing, and computer mediated conferencing. Furthermore, ICT gives rise to producing digital resources, such as digital libraries, wherein efficacy, and academic motivation, and reported that academic self-concept could predict academic motivation toward school. In another study on school status, achievement motivation, and academic motivation, Gunuc et al. and Kuzu (2015) concluded a significant positive relationship between students' perceptions of school status and their achievement motivation and academic motivation, which could indirectly predict the school status based on conditions, facilities, and technological equipment related to enthusiasm. Cadima et al. (2015) in their study, reflecting on the effect of self-regulation and teacher-student relationships on students' academic achievement, settled that higher self-regulation and close relationships with teachers could forecast students' academic achievement. Moreover, the relationship between teachers and students could be intensified or

reduced due to ICT. Gunuc et al. (2015) in a study aimed at modeling the impact of the school environment and its technological facilities on academic enthusiasm (viz., behavioral, cognitive, and emotional). Nurttila, Ketonen & Lonka (2015) investigated the feelings of being competent and optimistic as a source of increasing academic enthusiasm and confirmed that a sense of competence in academic pursuits and optimism could be empowered and ultimately enhance competence.

History of ICT Use in English Education.

English has been acknowledged as one of the basic skills in different dimensions of students' lives. It is also necessary in each community, and English ematical operations are considered as one of the largest parts of the daily routines (Esteves, Arede, Travassos & Dicks, 2021). For example, Sadovsky (2007) focuses on the necessity of re-thinking the learning and teaching process of English, expanding thoughts on the materials to be learned, and illustrating the actual significance of this knowledge in the daily lives of students.

Put differently, the impacts on social life expanded by ICT represent one of the specific opportunities to develop education because such occasions can simplify meaningful learning via technological resources. Hence, the integration of more interactivity and exciting ICT technologies, the exploration of amusing digital resources such as educational games, videos, and images for supporting English learning and teaching, and simulators, as well as other applied sciences in English classrooms to encourage students and teachers, are the feasible ways to facilitate the current situations (Saad, Murugiah, Abdulhamid, Yusuf & Fadli, 2014; Shakuna, Mohamad & Ali, 2016; Valizadeh & Soltanpour, 2021).

For this reason, mobile tools, including tablets and smart phones are among the major options for developing projects to integrate ICT into educational contexts due to their affordability, robust hardware, and main developments (UNESCO, 2014).

These days, all communities are also experiencing continuous changes with the emergence of technologies and the sciences that result in people's contact at an earlier age with technological resources. Hence, tools such as mobile devices and computers have been part of the recent culture. Consequently, technology can have a major function considering the educational support in education systems. In fact, dynamics in English classrooms may be transformed with the use of ICT and mobile tools, which can be very promising in this regard.

Some applications of ICT are presented here. For example, calculations may be used by students, graphs can be plotted, and some problems can be solved by ICT. Moreover, a major illustration of the utilization of ICT is associated with the use of a calculator for performing more challenging numbers. Nonetheless, computer algebra systems, graphing calculators, and spreadsheets can be applied for solving problems via retrieval or improvement methods and tests. In addition, students may employ graph plotters or

graphing calculators rather than algebra to present the graphical solution of equations (Ali, 2021).

In more advanced steps, students can statistically analyze data and make use of several statistical features of graphing calculators for data collection. Furthermore, producing images in dynamic geometry packages may further enhance students' understanding and problem-solving methods, which then approve geometric problems. The use of ICT as an instrument to help students solve problems, search things out, and understand situations can also expand their skills in the application of English. Therefore, ICT is one of the efficient tools, but students must learn the necessary technical skills in order to seize the effective and constructive opportunities provided to them. It is possible to employ ICT in numerous aspects of English even though the cases mentioned below are the most useful ones:

(1) English and problems
(2) Formulae, identities, and equations
(3) Order, rounding, and position value
(4) Geometrical argumentation, including angles, shapes, and lines
(5) Functions, graphs, and sequences
(6) Coordinates (viz., coordinate geometry)
(7) Probabilities
(8) Transformations
(9) Statistical uses
(10) Loci and construction
(11) Data handling

Moreover, the English Aid software, as one of the browser-based applications that can be accessed by mobile devices, supports students in their self-studies of English in and out of classrooms. In fact, students are capable of using this software as one of the tools for following the curriculum and as a compliment to the common high school English books. The given software deals with a theoretical section introducing the chosen English ematical concepts, the respective learning assignments with solutions, hints concerned with students, as well as concrete examples of the studied phenomenon for guiding them to the solutions of chosen tasks and assignments. This software presents tools to teachers for monitoring students in classrooms and at individual levels. Its learning assignments have also been designed to be interactive and self-instructional, followed by explanations, calculation steps, and moving graphs, which can visualize English. Finally, the given software can be accessed by desktop computers, smart phones, tablets with both Android and Apple's iOS operating systems and laptops.

In addition, experts have introduced Maxima as one of the algebra solver software that is based on LISP, as a computer language, and deals with each POSIX principle such as Unix,

Linux, BSD, and Mac OS X. As well, Gnuplot is utilized for drawing purposes in this software.

According to the experts in the field, GeoGebra has been considered as one of the English software beneficial to students as well as teachers. In fact, this software is a powerful platform, helping preschoolers in effective learning of English and solving its problems, including calculus, vectors, algebra, linear programming, statistics, complex numbers, and so forth.

Furthermore, SymPy has been introduced as one of the Python archives for symbolic English, aiming at turning into a full-featured computer algebra system (CAS) by maintaining the codes in the simplest state for more comprehensibility and easier extension. Thus, the main research question addressed was as follows:

"Is teaching English with ICT-based method of instruction more effective in the academic enthusiasm of ninth-grade students than conventional education or not?"

Methodology

The research method was a quasi-experimental approach with a pretest-posttest design and a control group. The statistical population included all ninth-grade students from lower secondary schools located in Jalingo town, Taraba State, Nigeria in 2021–2022. The convenience sampling method was also used since there was a need for appropriate facilities and technical infrastructure in schools as well as basic skills among students. For this purpose, one school equipped with the Internet, computer workshops, and projectors in Jalingo was selected. Then, two classrooms at a given school were randomly divided into two experimental (ICT-based education) and control (conventional education) groups. The academic enthusiasm pretest was further taken from both groups before the beginning of the semester. Ethical considerations were taken into account at all stages of this study. Since a reflective written report as a kind of interview may involve the risk of probing into participants, private lives, the study's participants were notified of any consequences regarding participation in the study. To this aim, a digital written consent was sent to them to be signed and returned to the researchers. Indeed, the participants were informed of the study's objectives and ensured that their names and responses would remain confidential.

Besides, the respondents were allowed to withdraw from the study whenever they asked for it. And, at the end of the study, they would be informed about the final results.

The lesson plan was designed for 12 sessions of 45 minutes. The educational content was accordingly prepared in the storyline software in a self-taught manner using texts, videos, teacher's voices, examples, exercises, and games. Two days before the classroom, the content was provided to the experimental group through the social network, but the control group received no interventions. At the end of the semester, the posttest was taken from both groups. In this study, gender, age, level of education, and teaching were controlled.

The Academic Enthusiasm Questionnaire (AEQ) developed by Fredricks, Blumenfeld, and Paris, consisting of 15 items and three subscales, viz., behavioral (items no. 1–4), emotional (items no. 5–10), and cognitive (items no. 11–15) using a five-point Likert-type scale (from never to all times) with the minimum and maximum scores of 23 and 115, respectively. In the research by Shahri, Kia-Dehi, Abadi and Pirani (2016), the concurrent validity of the questionnaire had been already approved by experts. The overall reliability of the AEQ using Cronbach's alpha method was 0.87, and it was 0.81, 0.72, and 0.82 for behavioral, emotional, and cognitive dimensions, respectively.

An analysis of covariance (ANCOVA) was also employed to test the research hypothesis, and Levene's test was employed to determine the conditions for establishing the variance between the group scores.

Data Analysis and findings.

Table 1: Mean and standard deviation (SD) of academic enthusiasm in the experimental and control groups.

Scale	Groups	Control group		Experimental group	
		Mean	SD	Mean	SD
Academic enthusiasm	Pretest	93.40	7.49	90.78	13.98
	Posttest	91.37	13.53	95.57	17.78

Source: SPSS Output 2023.

Table 2: Normal distribution.

Variables	d.f.	z	p
Academic enthusiasm	52	0.44	0.000

Source: SPSS Output 2023.

Table 3: Equivalence analysis of variances based on Levene's test results.

Variables	d.f1	d.f2	F	p
Academic enthusiasm	1	52	0.018	0.894

Source: SPSS Output 2023.

Table 4: ANCOVA results for the difference between the mean scores of academic enthusiasm in the experimental and control groups.

Variable	Source of change	Sum of squares	F	Mean squares	d.f.	p
Academic enthusiasm	Interconnection	13466.13	154.49	13466.13	1	0.000
	Group	360.67	4.13	360.67	1	0.047
	Error	4445.34	–	87.16	51	–
	Total	4935.00	–	–	54	–

Source: SPSS Output 2023.

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According to the descriptive statistics related to academic enthusiasm in the experimental and control groups, as outlined in Table 1, the posttest mean score of the students in the experimental group with regard to the variable of academic enthusiasm was higher in comparison with that in the control group.

Table 2 shows the Kolmogorov–Smirnov test results in terms of examining the distribution of academic enthusiasm mean scores. Since $p > 0.05$, then the assumption of the normalization of the distribution was established, and the academic enthusiasm outcomes showed a significant level of $p > 0.05$.

Moreover, the Kolmogorov–Smirnov test results demonstrated a normal distribution of the mean scores of academic enthusiasm. The comparison of the ICT-based and conventional methods of instruction on academic enthusiasm is provided in Table 3.

Regarding the research question, "Is teaching English with an ICT-based method of instruction more effective in the academic enthusiasm of ninth-grade students than conventional education or not?", the mean scores of academic enthusiasm in the experimental and control groups after removing the pretest effect were significantly different, and it was concluded that the ICT-based education was more effective in the students' academic enthusiasm than the conventional one with a 95% confidence interval (Table 4).

Discussion and Conclusion

In the present study, the research hypothesis that English education via ICT could be more effective in the academic enthusiasm of ninth-grade students than the conventional method of instruction was confirmed, which was consistent with the findings by Bexton, Wiersma, Getu (2015), Bashpour et al. (2013), Kavetsos and Koutroumpis (2010), Naeemi, Hormosi, Shaghaghi, and Kaveh (2012), and Moradi, Heydari, Salehi and Puti, (2017), investigating the effects of using ICT in the learning and teaching process of English as well as increasing students' efficiency and consequently stimulating their academic enthusiasm. Three results of this study are in line with those of Nejad and Karami (2019), who compared the effects of traditional education and ICT-based education on students' academic enthusiasm in the eighth grade of middle school in Javanrood. They concluded that there was a significant difference in academic enthusiasm among experimental and control groups. The research results showed that the ICT - based education method has more effectiveness in comparison with traditional education in terms of the student's academic enthusiasm. In fact, the similarity of the research results is based on the fact that each of the studies conducted before refers to the impact of the use of ICT in teaching and learning, and the use of ICT is considered to be effective in promoting happiness, satisfaction, effectiveness, and academic motivation, all of which are associated with academic enthusiasm and make fundamental changes in their interpretation of the world through conversation with the teacher and their classmates.

In an ICT-based learning environment, students gain the ability to analyze and evaluate new knowledge using dynamic information transmitted through online communication, thereby providing learners with dynamic and active participants in building knowledge about their passive past.

It will be converted to receive information. In this space, the presence of a participatory atmosphere will involve students in complex projects and help them acquire skills to solve life problems, and this issue will help learners to become Academic enthusiasm enthusiastic thinkers, so it can be said in learning environments that are based on information and communication technology. The two basic elements of interaction and a participatory atmosphere will grow. The use of information and communication technology in the classroom and in the learning process as a learning medium changes the basis and structure of learning and changes the roles of teachers and students. If teachers and learners are ready to use and apply these tools, then they will use more of the potential and capabilities of these tools. They can make the possibility of using ICT in the educational process more possible for the student, and most of the students can provide a learning focus, perhaps using the tools involved and other new tools such as multimedia, images, videos, and sounds that are fun to teach, while the text is played, or even the movement of writing for students. It fascinates and amazes them, and they focus on what they need to learn with an attachment away from burnout and boredom, and their enthusiasm increases.

Information and communication technology-based education can provide students with an enjoyable learning environment free from any fear of humiliation or worry, full of psychological security and with inner motivation, and happiness. Here, both the teacher and the student search for information with more interest and motivation. In fact, ICT-based education, in addition to increasing learning and intrinsic motivation, allows learners to make the most of different learning styles. Also, supportive feedback and timely guidance from the teacher will reduce exam anxiety, increase sense of responsibility, increase participation, share information and improve learning, which shows the valuable role in the academic desire for knowledge shows the students' environment. The study has a significant impact on attracting students to the classroom. Unfortunately, in recent years, several factors have caused students to flee from learning environments, especially in low-income areas and due to the employment of students in more fake jobs.

Without the traditional doubts, providing facilities in the school and avoiding the methods and speech of the teachers, in addition to making the learning environment attractive and effective, will also improve the students' happiness and vitality, and this factor directly and indirectly. It can affect students' academic performance and motivation. In addition, despite the arrival of information and communication technology in many educational centers, teachers and educational officials are still not aware of the value of using it alongside traditional education and use traditional teaching methods due to the dramatic

changes in science and technology. The information obtained and the new theories and approaches to science and its teaching methods suggest that experts and teachers in the field of education should stop transmitting scientific facts and emphasize the content of the courses exclusively, because while learning the scientific methods, it is not possible to acquire scientific attitudes with traditional methods and they should use new methods instead. On the other hand, because students spend a very high proportion of their time in school and in the future will be responsible as there will be different areas, so it is doubly important to study the variables that affect their behavior and academic performance.

In the ICT-based learning environments, the use of multimedia could thus add to the attractiveness of the learning process and thus students could feel less tired and more eager to be in learning environments. In such environments, wherein learning experiences are enjoyable, students could feel more self-confident and have no depression and burnout. On the other hand, students could be more motivated and satisfied due to the variety of content presented and different learning styles. Benefiting from information resources and receiving instant feedback from teachers could correspondingly augment interaction and optimize learning, and also improve academic performance and enthusiasm. Research shows that ICT-based education provides the necessary conditions to strengthen students' academic self-concept and, accordingly, enhance students' academic enthusiasm.

Based on the study findings, the ICT-based method of instruction for English could elevate students' academic self-concept and their mental health. As a result, students' interaction and comprehensive growth could lead to higher levels of academic enthusiasm. Finally, the production of media by students could result in the further development of a positive academic self-concept and thus increase their enthusiasm for English. No doubt, the requirements to use ICT in curricula are as follows:

(i) In-service training in the application of ICT-based teaching (especially in classrooms where students are less eager to interact and participate) should be provided to teachers
(ii) It is better to identify and appreciate teachers using this type of education
(iii) Schools should be equipped with ICT and then school principals implement it
(iv) Teachers and students ought to be supported to exploit the unlimited capacity of ICT in classrooms
(v) It is recommended to utilize podcasts in ICT-based education

Therefore, the following are the research suggestions:

(i) Investigating ICT-based education in other subjectsStudying ICT-based method of instruction at different levels of education systems and universities
(ii) Examining students' enthusiasm using other new methods
(iii) Exploring ICT-based education in male students

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(iv) Reflecting on the effects of ICT in classrooms on other variables in future research, such as academic burnout, and academic adjustment

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E-ISSN: 1116 - 3240 P-ISSN: 3026-9334
MPRI-JAIMR | INTERNATIONAL JOURNAL OF AFRICAN INNOVATION & MULTIDSCIPLINARY RES.
VOL. 03 NO. 2 – JANUARY, 2024

ASSESSMENT OF SUSTAINABLE AND SAFE WATER SUPPLY OF BOREHOLE IN BORDING SCHOOLS IN MINNA METROPOLIS, NIGER STATE, NIGERIA

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Keywords:
Sustainable, Assessment, Safe, Water, Borehole, Bording Schools.

Abstract

Interest in this reaserch stems out of an observation by the aurthor of gradual, but decreasing rate of the sustainability and safe borehole water supply in State owned Government boarding schools in Minna metropolis. The study determined the sustainability of borehole water, evaluate the quality of borehole water supply and identify the alternative water sources in the study area. A four lickel scale structured questionnaire was employed to collected data on the sustainability and alternative water sources of the borehole in the study area. Water samples were collected from five sampling stations namely GGSS Maryam Babangida,ABSS Minna,GSS Minna. GGSS Old Airport and GTC Tungan Goro respectively.Frequency distribution, Mean and standard deviation were employed to analyze the result. Physicochemical analysis was conducted on the water samples and the results were compared to WHO drinking water standard. The results revealed that the major source of water supply in the study area is the borehole with mean value stands at (3.21). The results also showed that most of the schools do not meet with their daily water demand as such led them into various degrees of hardship and health challenges. Technical challenge, nonchalant attitude of Government school management towards fixing damaged boreholes with mean values stands at (2.12) and (1.52) respectively was also identified in the result. The physicochemical parameter measured are EC,TDS,TURB.pH.Temp.Ca.mg and Fe respectively. The results revealed indicated that all parameters measured were found within acceptable limits of WHO except a high concentration of EC (1012.50±12.50) at GSS Minna sampling station and Temperature from the five

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sampling stations went above the (23.5^{0}) WHO acceptable limits. The result also showed that the alternative water sources are pipe borne water (2.11) and well water sources (1.82) respectively. The research concludes that there is high concentration of some pysico chemical parametres in some stations in the area studied which affected its potability and geologically, the study is a basement complex region of which underground water may not be sustainable in all places. In the light of this, emphases should be put in place in the development of surface water sources in other to provide sustainable water in all location in the study

Introduction

Supply of sustainable and safe water is essential for human development both for supporting life and major human activities in society. Access to safe and affordable drinking water is a fundamental human right and a cornerstone of sustainable development (Bain et al., 2014). The United Nations Sustainable Development Goal 6.1 (SDG 6.1) specifically aims to 'achieve universal and equitable access to safe and affordable drinking water for all by 2030' (United Nations,2015). This target is critical, as it improves public health and well-being and has significant implications for other Sustainable Development Goals (SDGs), such as poverty alleviation, gender equality, and economic growth (UN-Water, 2016; Satterthwaite et al., 2020, Aly et al., 2022). Achieving SDG 6.1 is crucial due to its far-reaching impact on the SDGs.

In developing countries, especially in sub-Saharan Africa, access to safe drinking water is hindered by numerous challenges, including rapid urbanization, population growth, climate change, and weak governance (Onda et al.,2012; Dos Santos et al., 2017). High rates of failed water infrastructure further exacerbate these issues, with estimates suggesting that as many as 40% of water points in the region have failed (Network, 2010; Foster & Hope, 2017). The failure of water projects can have severe consequences for local communities, contributing to water scarcity, poor health outcomes, and persistent poverty (Whaley & Cleaver, 2017; Prüss-Ustün et al., 2019).

Nigeria exhibits substantial variations, impacting both its economic conditions and water management. Borehole water and other groundwater sources play a crucial role in meeting the water needs of Nigerian communities. However, a concerning trend of borehole failures and non-operational water supply infrastructure persists (Andres et al., 2018), Despite significant investments in water infrastructure, only 67% of the Nigerian population has access to basic water services, leaving a stark 33% underserved and emphasizing the significant unmet demand for sustainable access to clean drinking water. Additionally, about 47% of water points are non-operational (Andres et al., 2018b;NPC & ICF, 2019; UNICEF Nigeria, 2020).

There is need for urgent interventions to prevent water shortages, particularly in boarding schools in minna metropolis where significant reports of waterborne infections

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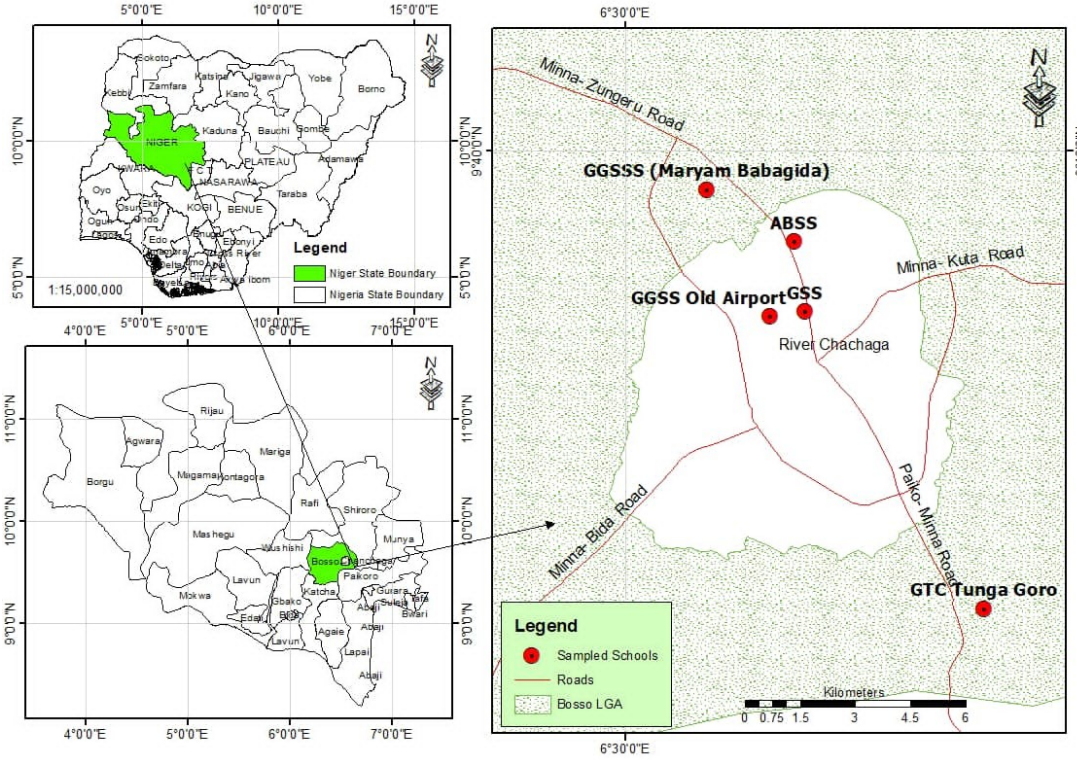
and diseases such as diarrhoea, cholera and typhoid occur as a consequence of poor sanitation and poverty The ground water availability and accessibility are vital for sustaining rural communities in Niger state (I. Ibrahim *et al* 2014).

Over the years and especially in recent times, Minna has witnessed unprecedented growth with its attendant problems occasioned by influx of people from other parts of the state for administrative, political, economic, educational as well as other purposes, just like most modern areas (Sule, 2011).The major sources water in Minna metropolis especially in Government own boarding secondary schools faces challenges to water availability highlighting the need for accurate assessment of ground water potentials and borehole water supply. Therefore, it is against this background that this paper seeks to access the sustainability and safe water supply of boreholes in boarding schools in Minna metropolis.



Title: Map of the study area

Source: Geography Department, Federal University of Technology, Minna (2023)

MATERIALS AND METHODS

Materials

This research work deployed the use of primary and secondary data sources which include. Primary, personal observations, photographs, Global Positioning System (GPS), water samples, and field work. The secondary data were sourced from Journals, Articles, thesis, online materials, NSDWQ and World Health Organization (WHO).

Methods

A questionnaire was administered to determine the sustainability of Bore-Hole water in the study area. Water sample was collected in accordance with the guidelines of American Public Health Association, APHA(APHA, 1998). In order to minimize the contamination of the samples, the entire samples were collected in fresh sample containers. The containers were acid-washed under running tap water, thereafter, rinsing with nitric acid solution of 1:1 andair-dried. Samples were collected and labeled properly. The samples were taking in an ice-pack cooler kit to the laboratory. The collection of the samples was done in the early hours(between 7 am to 9 am), January and February 2023, pick dry season, August and September 2023, pick wet season. 24 water sample was collected and subjected to physico-chemical analysis and a structural questionnaire was deign to Identify the alternative water sources in the study area.

Population of the study

Population simply refers to the total group of people, events, or things that the researcher is investigating (Majidi, 2016). This research covered all the boarding students in the study area.GSS Minna with 33 boarding students, GTC Minna 302, GGSC Maryam Babangida 710, ABSS Minna 252 and GGSS Old Airport Minna 320 respectively.

Sample and Sampling Techniques

Krejcie and Morgan (1970) table was used to determining sample size of this research. The table is constructed using the following formula for determining sample size.

Formula for determining sample size

$S=X^2NP(1-P)+d^2(N-1)+X^2P(1-P)$

S=required sample size.

X^2 = the table value of chi-square for 1 degree of freedom at the desired confidence level (3.841).

N= the population size

P= the population proportion (assumed to be 50 since this world provide the maximum sample size)

d = the degree of accuracy expressed as a proportion (05)

source: Krejcie and Morgan 1970.

A statistical random sampling was used to administered questionnaire in study area.

Methods of Data Analysis

Frequency, mean and standard deviation was used and compare with WHO drinking water quality standard to ascertain the quality of domestic water sources in the study area.

Results and Discussions

Table 1.1: The mean standard deviation of sustainability of Bore-Hole water in the study area.

VARAIBLES	N	MEAN	STD. DEVIATION
Borehole is the main source of water in your school?	310	3.21	.840
Do you meet up with your daily water demand?	310	1.98	.566

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Are you satisfied with the borehole water provided?	310	1.98	437
Technical challenges are experience with borehole in your school?	310	2.12	.582
Technical challenges take longer time to be fix in your school	310	1.52	.787
Do governments or School Management make effort to improve sustainability of water supply?	310	1.93	.719
			,765

Source: Field 2023

The table above indicates that borehole is the major sources of water in the study area. The mean stood at (3.21). The mean of the daily water demand is (1.98) this in other words, shows the level of sustainability of borehole water in the study area. The level of satisfaction with the borehole water provided in the study area was indicated in the table above where the mean value stands at (1.98). The mean (2.12) shows that technical challenges with the sources of water in the study area. Also in the table above indicated the level of effort made Government/school management ensuring the faulty bore holes are fixed stands at (1.52). The effort to improve the sustainability of water supply by government and school management has the mean of (1.92).

TABLE1.2: The shows the mean and Standard Deviation of physicochemical parameters of for Bore Holes in the study area.

Sampled Stations	Ecb(µS/100mL)	TDSb(mg/L	Turbb(NTU)	PH	Tmepb(OC)	Cab(mg/L	Mgb(mg/L	Feb(mg/L
GGSC Minna	171.75±9.21	93.5±10.44	0.00±0.00	6.63±0.04	27.150±0.75	31.35±1.05	6.10±0.25	0.04±0.00
ABSS Minna	547.50±22.87	275.00±9.57	0.00±0.00	6.725±0.14	27.975±0.46	31.35±1.05	6.10±0.25	0.04±0.00
GSSS MINNA	1012.50±12.50	512.50±12.50	0.50±0.29	6.500±0.04	28.250±0.27	69.62±1.11	16.75±0.85	0.05±0.02
GGSS D/A Minna	123.50±2.36	75.50±12.39	0.00±0.00	6.600±0.08	27.950±0.45	8.42±0.19	6.50±0.29	0.04±0.01
GTS Tungan Guru	100.00±45.09	46.67±16.67	0.50±0.29	6.500±0.00	27.900±0.64	35.04±1.31	29.79±0.93	0.03±0.01
WHO	1000	1000	5	8.55	23.5	200	0.2	0.3

FIELD WORK 2023

TABLE1.2: The shows the mean and Standard Deviation Of physicochemical parameters of for Bore Holes in the study area.

The result revealed that Electrical conductivity (EC) remains highest at Government Secondary School MInnna (1012.50±12.50mL) which exceeded WHO permissible standard. Also (EC) showed lowest concentration at Government Technical College Tugan Goro and the mean and Standard deviation stood at (100.00±45.09). The mean and standard

deviation of (EC) at Government Girls Science Secondary stood at (171.75±9.21) and (547.50±22.87) at Ahmadu Bahago Secondary School respectively. The result shows that Total Dissolved Solid is highest (512.50±12.50mg/L) at GSS Minna, lowest (93.5±10.44mg/L),at GGSC, (275.00±9.57mg/L) at ABSS, (75.50±12.39mg/L) and (46.67±16.67mg/L) respectively. Table 4.2 shows that Turbidity concentration in the study area maintained a steady concentration of 0.00±0.00 in virtually all the sampled area with exception of GSS Minna with a mean value of 0.50±0.29.The PH mean values ranges between 6.725±0.14 and 6.500±0.00 all sampled stations. Temperatures also range between 28.250±0.27at GSS Minna and 27.150±0.75 at GGSS. Temperature is high all across the sampling stations. Calcium was also sampled in the study area and the results revealed that GSS Minna Bore-Hole has the highest value with (69.62±1.11) and the station with the lowest value is the GSS Minna with (8.42±0,19)Magnesium was generally high and the highest value was recorded was at GTS Tungan Goro (29.79±0.93), Gsss Minna (16.75±0.85), (6.50±0.29) at GGSS old airport,(6.10±0.25) at GGSS and ABSS respectively. All the mean value for tubidity was above the WHO permissible limit. GSSC has the mean value of (0.04±0.00), ABSS (0.04±0.00), GSS (0.05±0.02), GGSS (0.04±0.01 and GTC (0.03±0.01).

Table 1.3: The mean and standard deviation of the alternative water sources in the study area

VARAIBLES	N	MEAN	STD. DEVIATION
The alternative water source in the study area is pipe born water	310	2.11	.895
The alternative water source in the study area is well water	310	1.82	.598

Source: Field 2023

The mean from table 4.3 indicated that the major alternative water sources are pipe born water (1.81) and well water source (1.82)

Discussion of The Findings

The results of the questionnaire administered in the study area are analyzed using mean and standard deviation. From the result revealed in table 1.1 (3.21) borehole is the major source of water supply in the study area. As boarding students, the water from the bore hole is needed for most domestic uses.eg drinking, cooking washing and other such cleaning, bathing etc.

The result from table 1,1 shows that most of the schools in the study area do not meet with their daily water demand. The shortage in water supply and availability may lead students to so many challenges that could be detrimental to their health and social life.

The mean and standard deviation for the daily water demand stood at (1.98) which far below the average.

One of the important reasons why the demand for water is not met is the technical challenges experienced in the study area. The mean value for this (2.12) fell below average and implies shortages in water supplyin the study area. A technical challenge arises from the way boreholes are handled by the students and lack of maintenance from school authorities. Also, spare parts are available but most times resource to procure spoiled spare parts becomes challenging as such students becomes stranded and begin to look for other alternative water source to meet up with their required daily demands. The result indicated that a lot of time is wasted before damaged boreholes are fixed. The mean value is (1.52) indicating a negative attitude of school authorizes/ Government in ensuring a swift repairs of damaged boreholes.

The mean value (1.92) in the table above indicated that despite government attempt in providing a sustainable and safe water supply in the study area, the goal is not yet realizable because virtually all school in the study area still experience challenges in water supply which affects virtually all facet of life of the students in the study area academically, health wise and in their social activities.

Table 1.3. indicates how safe bore hole water is, when compared to WHO drinking water quality. The results from the table revealed that EC went above the WHO permissible limit at GSS Minna borehole (1012.50±12.50). The high level EC increase amount of impurities (dissolved substances, chemicals and mineral.) Electrical conductivity (EC)for GGSS(171.75±9.21), ABSS(547.50±22.87),GGSS Old Airport Minna(123.50±2.36),and GTC Tugan Goro (100.00±45.09)fall within the permissible limits. Total dissolved solids (TDS) are the term used to describe the inorganic salts and small amounts of organic matter present in solution in water. The principal constituents are usually calcium, magnesium, sodium, and potassium cations and carbonate, hydrogen carbonate, chloride, sulfate, and nitrate anions (Rubiat Islam & et ai,.2017) TDS in the study area fall within permissible limit (1000mg/L), of the WHO. The TDS at GGSS has a mean value of (93.5±10.44),ABSS (275.00±9.57),GSS Minna(512.50±12.50),GGSS Old Airport (75.50±12.39) and at GTC Tungan Goro (46.67±16.67). The result is in agreement with work of (Rubiat Islam & et ai,.2017) where all samples at all stations were measured within the WHO permissible limits. The WHO permissible limit for turbidity is 5 (NTU). The result revealed from all sampling station fell below the minimum standard but varies in the mean values. The mean value at GSS Minna and GTS Tugan Goru has the highest mean value of (0.50±0.29)while GSSS,ABSS, and GGSS Old Airport recorded (0.00±0.00) turbidity (NTU) values. The PH values were measured within the WHO permissible limits as all the sampling stations ranges between 6.5 - 6.7 respectively. The values recorded were also in agreements with the work of (Muhammad T. B . et al.,2020) with values between 6.1 to 6.6 in the underground water in Tudun Fulani Niger State. Temperature from all the sampling stations were measured above the 23.5 WHO minimum permissible values. The

highest mean value for temperature measured was at GSSS minna(28.250±0.27) the lowest mean value recorded was at GGSSS Old Airport (27.150±0.75). Others mean value measured were (27.150±0.75) at GGSSS, (27.150±0.75) at ABSSS (27.950±0.45) respectively. A comparable mean values (28.1+1.02), (29.3+ 0.50),(29.3+ 0.50),and (28.4+ 0.71) were measures in the work of (J. C. Nnaji & S. Omotugba22014).

Calcium result shows that all the mean values is within the WHO permissible limit as against the 200mg/L of WHO drinking water quality. however, the following mean values were measured across the sampling stations and the highest mean values was at GSSS (69.62±1.11) and lowest at GGSS Old Airport (8.42±0,19), GTS (35.04±1.31) and GGSS and ABSS has same mean values of (31.35±1.05) The mean values for (mg) show a higher concentration and above the recommended value of WHO drinking water standard. These values were recorded highest at GTC Tugan Goro(29.79±0.93), GSSS (16.75±0.85) and maintained same mean values of (6.10±0.25)at GGSS,ABSS and GGSS Old Airport. High concentration of iron might be due to deteriorated metal scraps, weathering of rocks containing iron and run-off of urban surfaces underground (Ranjana, 2009; Olasehinde *et al*., 2015; Amadi *et al.*, 2017) and could allow iron-dependent to flourish and thus result in further deterioration in the quality of water through the advancement of sledges. The mean concentration of iron in the water samples was found to range between 0.03±0.01 – 0.05±0.02 mg/L. This signifies that the concentrations are bearable, with all the samples falling within the WHO (2011) stipulated limit of 0.30 mg/L. The results obtained were far below the mean average of 0.50 mg/L reported by Ojutiku *et al.* (2014) for borehole water in Bosso, Niger State and 0.07 – 0.65 mg/L obtained by Amadi *et al*. (2017) for hand-dug well water in Lapai, Niger State.

Pipe borne water is the major alternative water source. The result indicated that pipe borne source is supplied in most of the schools but not on regular basis. Despite that, pipe borne was ranked over well water with mean value of (2.11) and (1.82) respectively.

CONCLUSION AND RECOMMENDATIONS

The study of physical and chemical properties of water provides reasonable background information into the sustainability and quality of underground water in the study area. It shows the need to improve on adequate supply of water in the study areas. The increasing concentration of various chemicals generated from subsequent release to the surrounding environment, as well as the domestic water, raised a wide spread and increasing public concern over their negative effects on human health and environment especially at GSSS Minna borehole.

The result from this study showed that the alternative water source is not reliable to provide adequate portable water supply in the study area.

Geologically, the study is a basement complex region of which underground may not be sustainable in all places. In the light of this, emphases should be put in place in the

development of surface water sources in other to provide sustainable water in all location in the study.

Ground water should be properly harnessed in order to reduce the dependence on surface water and reduce the incidence of water related diseases. The study area is prone to health risks as a result of the unsanitary conditions of many of the boreholes studied thus there is need for improvement and reconstruction of the boreholes.

Spare parts and faulty parts should be replaced and fixed to avoid short fall in the provision of portable water supply in the study area.

Boreholes in the study area should be properly monitored periodically by the concerned authorities so as to maintain WHO physicochemical and bacteriological drinking water guidelines. Communal awareness on the risk of sitting waste dump sites close to boreholes water and movement of roaming animals around borehole water source is necessary. A further study on the quality of borehole water in the study area is recommended.

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