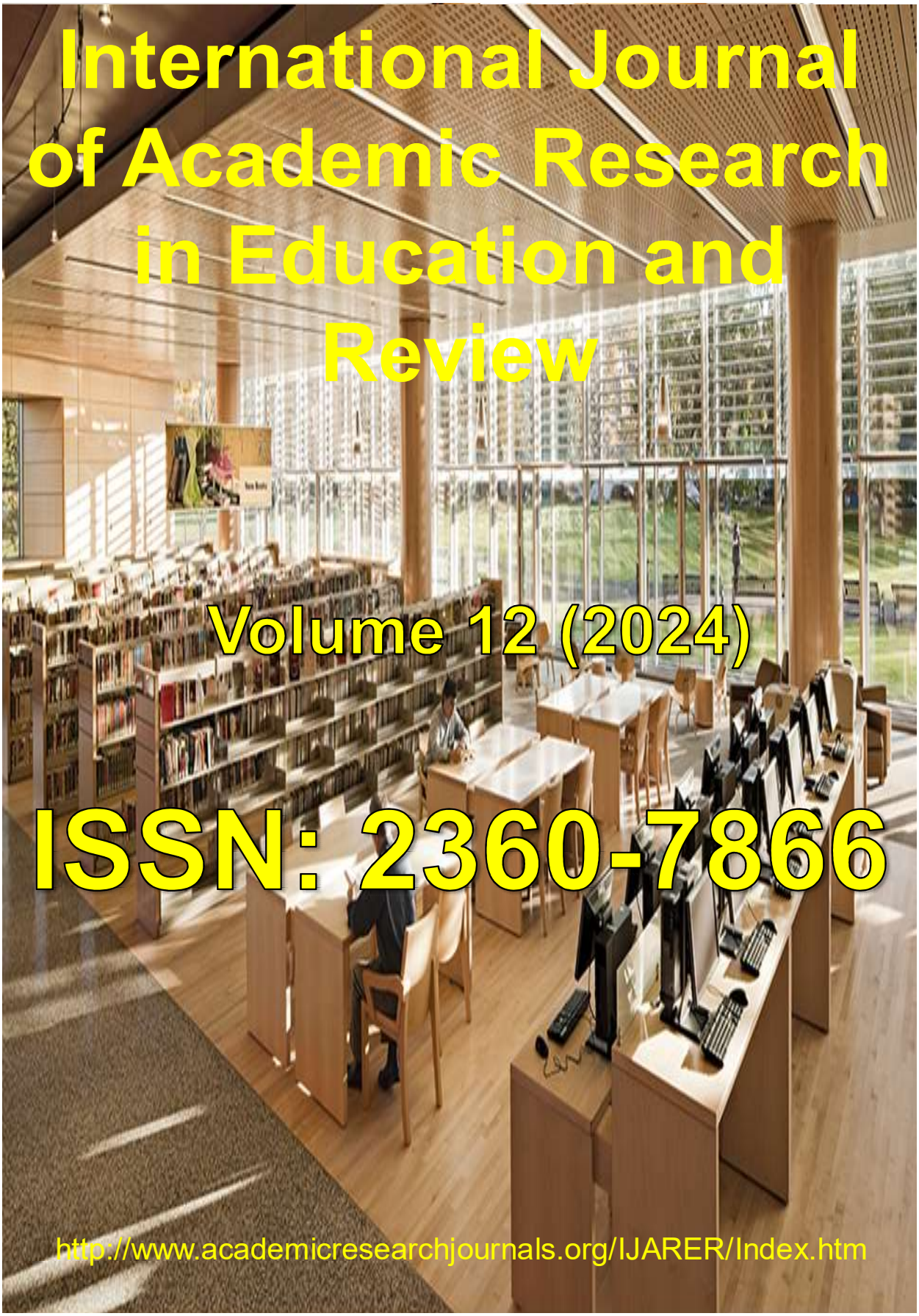

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Full Length Research

Assessment-mode Preference: A Factor towards High Academic Achievement in Senior Secondary School's Economics

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When assessing students' attitudes toward high academic performance in secondary schools, assessment mode preference appears to be taken into very little account. Hence, the study. Four research questions based on the Economics Students' Assessment Attitude Scale (ESAAS), a 31-item questionnaire, with a Cronbach's alpha reliability coefficient of 0.89 were examined in this study. The sample comprised 354 respondents from 5,766 SS 2 students spread over four local government areas of Oyo State. There is a strong relationship between gender and the way economics students approach assessments. The respondents' age significantly influence the way economics students feel about assessments. The combined effect of assessment-mode preference and subject relevance is statistically significant in predicting economics students' assessment attitudes. Finally, yet importantly, a considerable portion of respondents' assessment mode preference favours home assignments over objective and essay items. It is advised that economics teachers make conscious effort to stimulate their students' attention. When choosing the evaluation technique to be employed, it is important to consider the students' assessment preferences. Subject teachers should provide students with additional homework to boost academic achievement in economics, which is the most preferred assessment mode.

Keywords: Assessment, Economics, Assessment-mode Preference, Assessment Attitude

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INTRODUCTION

Assessment is described as "a purposeful, systematic, and collaborative process driven by the institution's desire to improve learning" (Rumiantsev, van der Rijst & Admiraal, 2023). Adewale (2008) defined assessment as a regular and ongoing procedure to measure how much a student has learned or accomplished a prescribed task in a school. This explains the importance of assessment in education as a tool to assist instructors and educators in assessing student learning progress, identifying areas for growth, and making defensible choices about instructional tactics. According to Adewale (2008), evaluating students' knowledge and understanding is a useful way to influence their behaviour.

Numerous assessment methods are employed in the field of education to gauge the learning and development of students. Typical forms of assessment include Summative Evaluation: This type of evaluation often occurs after a unit of instruction or a course to gauge students' overall performance (Centre for Innovative Teaching & Learning, 2023). Final exams, standardised assessments, or year-end performance reviews are a few examples. Summative evaluations offer a thorough review of what the pupils have learned. The other is formative evaluation. Continuous formative assessment aids teachers and students in tracking learning development throughout the teaching process. It offers insightful feedback that can be utilised to alter teaching strategies and enhance student comprehension (Juwah, Macfarlane-Dick,

Matthew, Nicol, Ross, & Smith,2004). Exams, homework, class debates, and instructor observations are a few examples.

Another type is diagnostic assessment. Before beginning a new unit or course, this is done to determine the students' skills, weaknesses, and prior knowledge. Teachers can better personalise instruction to each student's needs with the use of diagnostic tests (Brown & Harris, 2021). Pre-tests, questionnaires, and interviews are a few examples. In addition to diagnostic testing, there are authentic tests, which concentrate on real world, practical tasks that mimic real-life scenarios (Lowell &Tagare, 2023). They demand that students apply their learning to concrete, applicable circumstances. Research projects, portfolios, presentations, and simulations are a few examples.

Performance tests are a type of evaluation that gauges how well pupils can do particular tasks or skills (Indeed, 2022). They typically involve active participation from the students in projects or activities that are hands-on. Oral presentations, experiments, shows, and artistic performances are a few examples. Self-evaluation is yet another unexplored assessment. Self-assessment gives students the ability to evaluate their own growth and development (Chung, Chen & Olson, 2021). It challenges people to assess their advantages, disadvantages, and opportunities for growth (Yan, 2022). To evaluate their own work, students can use a variety of tools, including notebooks, checklists, and rubrics. Finally, peer assessment entails students commenting on one another's work (Hanlon, Murray & Niculae, 2020). It promotes teamwork and critical thinking and offers chances for helpful criticism. Group assignments, peer reviews, and group conversations can all be used for peer assessment.

Each form of assessment has a distinct function and can offer important insights into students' development. A combination of these tests can provide a thorough picture of students' progress and support teachers in making defensible instructional choices (Munna & Kalam, 2021). Typically, achievement tests are used to undertake institutional or school assessments. Achievement tests, a measure of the cognitive domain, are made to offer empirical information about how well a person has completed a training or course of study (Osebhohiemen, 2019). Achievement tests, however, only show the level of students' cognitive abilities and ignore other domains. Poor focus on other areas that can foster great performance calls for attention. Therefore, it is an aberration to ignore the emotive domain, which is concerned with how students perceive and behave toward a given subject (Goetz, Haag, Lipnevich, Keller, Frenzel, & Collier, 2014).

According to several sources, attitude is an assessment of a person's mental and psychological propensities or dispositions toward an object, event, or thing, which can be positive or negative. Researchers like Kpolovie, Joe, &Okoto (2014) focused on the relationship between motivation in learning and attitude toward school, while Adeyemo, Onongha & Agokei (2009) looked at attitudes toward teaching. Oladimeji (2023) evaluated students' learning attitudes. Others have looked at pre-service teachers' attitudes toward diversity and inclusion, including Garmon (2004), Turner (2003), Johnson & Howell (2005), and Turner (2003) on attitudes toward inclusion and technology. Regarding students' attitudes toward assessment mode, very little study has been done. Miron (2014) to ascertain their attitudes toward various evaluation methods surveyed 346 Israeli undergraduate students. In a separate study, Abu-Dabat (2014) examined and quantified the impact of students' attitudes toward evaluation methods at the faculty of arts at the Jordanian Al-Zaytoonah University on their overall performance in a few academic disciplines, specifically curriculum and teaching methods. These studies on assessment methods and evaluation systems had university students as their primary subjects.

The method or setting used to assess students' knowledge, abilities, or skills is known as the assessment mode (OECD, 2018).Assessments are commonly used to gauge how well students grasp a particular subject or how far they have come academically generally. The subject, educational level, and evaluation objective can all influence the assessment method. When in assessment mode, teachers can use a variety of assessments, such as tests, projects, presentations, and performance-driven assignments (Sanga, 2016). Teachers and students can identify their regions of competence and potential for development with the use of these exams, which offer pertinent feedback. Teachers can measure students' learning outcomes, monitor their progress, and create lesson plans that work with the aid of the evaluation mode (Ghaicha, 2016). Students may exhibit their knowledge and abilities in the evaluation mode through written answers, oral presentations, practical exercises, or other appropriate formats. Exam results can be used by teachers to assess their students' learning, give feedback, and adjust lessons in the wake of finding any gaps or misconceptions. The assessment mode also helps to pinpoint areas that can benefit from extra guidance or enrichment (Indeed, 2022).

A student's performance as well as the general effectiveness of the curriculum, instructional strategies, and educational initiatives can all be evaluated using the assessment mode. By acquiring and reviewing assessment data, educational institutions can enhance their methods for teaching and learning. It is crucial to keep in mind that the assessment process should be planned and executed in a fair, trustworthy, and valid manner. This guarantees that test results fairly reflect students' skills and knowledge and that they can be applied to make informed choices. To make sure that the assessment mode best supports students' learning and development, education specialists and professionals are responsible for devising and putting into practice appropriate assessment strategies. When doing this, professionals

take into account how students prefer to be assessed when determining the intended results. According to Van de Watering, Gijbels, Dochy, & van der Rijt (2008), assessment (mode) preference is described as an imagined choice among assessment options with the potential for ranking these choices. According to Adewale (2008), test professionals have categorised achievement tests (assessment mode) using a variety of criteria. Essay-type and objective-type are two categories for assessment mode. Contrarily, subject relevance is a key idea that entails picking and creating learning activities, assessments, and instructional materials that are relevant and in line with the desired learning goals. Students are more likely to participate actively, comprehend ideas thoroughly, and apply what they have learned to practical situations when the material is relevant (Darling-Hammond, Flook, Cook-Harvey, Barron, & Osher, 2020). The goal of subject relevance is to give students a meaningful education that prepares them for the possibilities and problems they will face in their personal and professional lives (OECD, 2018).

Assessment modes, which are used to gauge students' levels of cognition, knowledge, competency, and skill acquisition, can take different formats such as multiple-choice test, essay test, hybrid tests of essay and multiple-choice questions, submitted homework, student projects, and student notes (Okwilagwe, 2011). The method used to gather and give this is referred to as traditional assessment mode, and it uses paper and pencil. On the other hand, computer-based testing (CBT) has become a viable alternative to conventional assessment methods in the use of technology in education. Online assessments, according to Rubab & Imran (2023), are frequently given via a learning management system (LMS) or other online platforms and come in a variety of formats, such as quizzes, exams, essays, and assignments. "Comparing the effectiveness of different assessment modes in higher education" was the major topic of a study conducted by Smith & Johnson (2018). The usefulness of project-based assessments, online exams, and traditional exams in evaluating students' learning outcomes is assessed in this article. In an associated investigation, Brown & Thompson (2017) examine how various assessment formats—such as essays, presentations, and multiple-choice exams—affect students' performance as well as how they view the worth and equity of the assessment procedure.

Gupta & Shukla (2020) review several assessment methods, such as practical exams, case studies, and simulations, and explain how they affect students' development of practical skills within the context of skill-based learning programs. A review of the literature was undertaken by Chang & Hsu (2019) to investigate assessment techniques that support authentic learning approaches, such as performance reviews, portfolio reviews, and peer reviews, and to highlight the benefits and drawbacks of each. In a separate review, Black, Harrison, Lee, Marshall, & Wiliam (2011) examine the research on using technology-enhanced formative assessment tools, such as interactive simulations and online quizzes, to increase student engagement and learning.

Assessment attitude has a significant impact on students' learning performance, according to researchers like Dhindsa, Omar, & Waldrip (2007), Birenbaum & Feldman (1998), and Struyven, Dochy, & Janssens (2005) who have studied the role of students' attitudes toward learning. The relationship between students' learning-related qualities and their attitudes toward two assessment styles (constructed response and choice response) was explored by Mussawy (2009) and Birenbaum & Feldman (1998). Students' attitudes about the two assessment forms (constructed response versus multiple-choice response) were discovered to be related to their learning-related cognitive and affective processes. In a different study, Birenbaum & Feldman (1998) compared students' attitudes toward the multiple-choice format and the open-ended format of exams with their perceptions of their academic self-concept, their use of reflective and agentic learning strategies, their test anxiety, worry, and emotionality, and their academic self-concept. They discovered that the multiple-choice format was substantially connected with sex, agentic processing, and methodical research. Additionally, the study reveals that male participants generally have higher favourable sentiments regarding the multiple-choice format than female ones. According to Abu-Dabat's (2014) study of students' opinions regarding evaluation systems, grades between male and female students differ significantly, favoring female students. According to Miron (2014), the three modes—paper, essay, and objective—are all seen favourably. Although students had positive opinions toward all three evaluation methods, papers received the greatest scores, while objective tests received the lowest ratings.Over the years, it has been observed that performance in Economics has encountered zigzag wave that has bothered the mind of all stakeholders in education industry.

This study was set to investigate the effect of gender, age, assessment mode preference and subject relevance as precursors towards high academic achievement in senior secondary school’s Economics.

METHOD

The research employed an *ex-post facto* design because the researcher did not manipulate any variable in the study. An attitude scale based on four point Likert scale (strongly agree, agree, disagree, and strongly disagree) was developed with the help of experts in the field. The researcher adapted items of the scale. The Students' Perception of Assessment Questionnaire (SPAQ) by Mussawy (2009) was modified to create the Economics Students' Assessment-

Mode Attitude Scale (ESAAS). The SPAQ has 24 elements; however, the ESAAS has 31 items that have been drawn from and adjusted to fit economics. While Section B of the ESAAS was focused on the primary 31 items concentrating on respondents' assessment attitude, Section A of the survey provided an introduction and demographic data about the respondents. In order to make sure the validity of the instrument experienced professor and experts in the field were consulted. The instrument's reliability coefficient and consistency were calculated at 0.89 using Cronbach's alpha.

The researcher surveyed by employing attitude scale in order to seek answers of the questions raised in the study. Three secondary schools from each of the four local governments of Oyo Educational zone were reached by researcher and research assistants contacts. Data from three hundred and fifty-five (354) students were received and analyzed. Data collected through attitude questionnaire was analyzed. Inferential statistics like the t-test and analysis of variance (ANOVA) were calculated to gauge the dispositions and to find out the association among different items of the factors.

Population and Sample

All economics students at Senior Secondary School 2 (SSS 2) in Oyo State made up the study's population. The participants were chosen using a multistage sampling process. Afijio, Atiba, Oyo East, and Oyo West are the four local government areas (LGAs) that were specifically chosen from the State and these form Oyo educational zone. In each LGA, three (3) schools were chosen at random based on the number of schools in the zone. Twelve (12) schools took part in the study. Out of five thousand seven hundred and sixty-six (5,766) students in the SS 2 classes, three hundred and fifty-five (354) students formed the sample for the study.

Research Questions

The following research questions were probed in the study:

1. Do gender and age have relationship with assessment mode attitude among economics students?
2. Is there any joint contribution of assessment-mode preference and subject relevance in the prediction of the assessment attitude among economics students?
3. What are the relative contributions of assessment-mode preference and subject relevance in the prediction of assessment attitude among economics students?
4. Which assessment mode do students prefer most in economics classes?

RESULTS

Research Question one: Do gender and age have relationship with assessment attitude among Economics students?

Table 1: Correlation Matrix table of Gender, Age and Students' Assessment Attitude

Variables	Gender	Age	Assessment Attitude
Gender	1		
Age		1	
Assessment Attitude	0.87	0.33	1

*** Significant @ p<.05; n= 354*

The inter-correlation matrix from table 1 reveals the relationship coefficients of predictor variables (gender and age) and the criterion variable (students' assessment attitude) reveals significant positive relationship between gender and students' assessment attitude ($r=.87$, $p<.05$). In addition, the result shows that age is significant on students' assessment attitude ($r=.33$, $p<.05$). This reveals that age of respondents correlates with students' assessment attitude. Hence, conclusion can be drawn that gender and age have significant relationship with students' assessment attitude in economics.

Research Question Two: Is there any joint contributions of assessment-mode preference and subject relevance in the prediction of the assessment attitude among Economics students?

Table 2: Regression Summary and ANOVA of Assessment mode preference and subject relevance to Students' Assessment Attitude in Economics

Multiple R = .67
R Square = .45
Adjusted R Square = .44
Standard Error = 4.31

Source of Variance	**Sum of Squares**	***df***	**Mean Square**	**F**	**Sig.**
Regression	5266.13	2	2633.06	141.62	0.00
Residual	6526.20	351	18.59		
Total	11792.33	353			

Table 2 shows that the multiple correlation coefficients (R) of the joint independent variables with the use of students' assessment attitude in Economics was 0.67. This implies that there is 67% association between assessment mode preference, subject relevance and students' assessment attitude in Economics, R square = 0.45. The adjusted R^2, which estimates the variance on criterion variable measure accounted for by the combination of the predictor variable, was 0.44. This implies that all the independent variables: assessment mode preference and subject relevance made 44% contribution to the variance in students' assessment attitude. Regression ANOVA produced ($F_{(2,351)}$=141.62, p<.05). This indicates a significant composite contribution of the two-predictor variables: assessment mode preference and subject relevance investigated in the study with students' assessment attitude in Economics is statistically significant.

Research Question Three: What are the relative contributions of assessment-mode preference and subject relevance in the prediction of assessment attitude among economics students?

Table 3: Relative Contribution of Regression Summary and ANOVA of Assessment Mode preference and Subject Relevance in the prediction of assessment Attitude among economics students

	Unstandardised Coefficients		**Standardised Coefficients**	***t***	**Sig.**
Model	B	Std. Error	Beta		
(Constant)	6.93	1.32		5.24	0.00
Subject Relevance	0.76	0.09	0.44	8.39	0.00
Assessment Mode preference	0.25	0.05	0.29	5.50	0.00

Table 3 shows the relative contributions of independent variables (subject relevance and assessment mode preference) on criterion variable (students' assessment attitude). The contribution of the independent variables in the prediction of students' assessment attitude in Economics is different. These are subject relevance (β = .44, t = 8.39, p < .05) and assessment mode preference (β = .29, t = 5.50, p < .05). The value of the standardised regression weighted associated with subject relevance and assessment mode preference show that they are potent predictors of students' assessment attitude in Economics. Moreover, subject relevance has greater contribution than assessment mode preference in the prediction of assessment attitude among Economics students.

Question 4: Which assessment mode do students prefer most in Economics classes?

Table 4: Descriptive Statistics on Assessment mode Preference

Assessment mode Preference	**Mean**	**Std. Deviation**	**N**
Objective Mode	2.74	0.94	354
Essay Mode	2.43	0.90	354
Home Assignment Mode	2.84	0.98	354

Table 4 reveals the mean value of each assessment mode preference considered in this study. The contribution of the preference modes are objective (*∑fx* = 2.74, *Sd* = .94, n = 354), essay (*∑fx* = 2.43, *Sd* = .90, n = 354) and home assignment (*∑fx* = 2.84, *Sd* = .98, n = 354). The descriptive statistics associated with objective, essay and home assignment modes show that home assignment is far preferred to objective and essay modes, while objective mode is preferred to essay mode.

Discussion of findings

The finding reveals a significant correlation between gender and assessment attitude among economics students. The result implies gender or sex play a significant role in predicting assessment attitude of economics students, and that teachers should often consider gender when observing attitude because female students highly demonstrate positive attitude to the study of Economics. The result of this investigation is consistent with the reports of Owan, Bassey, & Ekpe (2020), Mamadelo & Adegbile (2020) and Birenbaum & Feldman (1998). According to Owan, et al. (2020), Mamadelo & Adegbile (2020) and Birenbaum & Feldman (1998), male and female students have quite different attitudes toward taking tests in secondary schools and the multiple-choice format, respectively. Abu-Dabat (2014), on the other hand, asserts that female students, as compared to male students, showed a greater overall ability to memorise the information and the contents of the topic. The results of this investigation likewise supported by Abu-Dabat's findings. However, the result negates the findings of Wheldall & Limbrick (2010) as cited in Mamadelo & Adegbile (2020).

The finding of this study indicates a significant relationship between age and students' assessment attitude in economics. The result connotes that age is significant in determining students' assessment attitude, that is to say, age bracket is enough to define students' disposition to learn and performing in Economics. Mamadelo & Adegbile's (2020), Abubakar & Oguguo (2011) and Birenbaum & Feldman (1998) uphold this result. Their reports reveal significant relationship between age and their dependent variables.

The result of joint contribution of assessment-mode preference and subject relevance towards assessment attitude is significant on students' assessment attitude. Van de Watering, et al. (2008) and OECD (2018) findings support this study. The combined effect of assessment-mode preference and subject relevance is statistically significant in predicting economics students' assessment attitudes.

The finding from this study reveals that students prefer home assignment (submitted homework) above objective and essay modes. This result corroborated Okwilagwe's (2011) identification of home assignment (submitted homework) as one of the assessment mode preference that is being used in evaluating students, and that has potential to improve students' performance in Economics.

CONCLUSION

This paper examined gender, age, assessment mode preference and subject relevance as precursors towards high academic achievement in senior secondary school's Economics. Owing to the result of the study, it has been observed that gender and age are essential in boosting students' attitude towards high academic achievement in Economics. In other words, students' attitude aids high achievement in school subjects. It is also established that the joint contributions of assessment mode preference and subject relevance on students' assessment attitude is significant to promote high achievement in senior secondary schools' Economics.

RECOMMENDATIONS

The researcher submitted that Economics instructors ought to make an effort to stimulate students' interests. When choosing the evaluation technique to be employed, it is important to consider the students' attitudes. Subject teachers should assign more homework to students to increase performance in economics through assessment mode preference. This will call for timely feedback and corrections, as well as regular marking of such homework or assignments.

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Full Length Research

Relationship between teacher interpersonal relationship and innovativeness and students' academic achievement in agricultural entrepreneurial subject in senior secondary certificate examination in Niger state

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The study determined the relationship between teacher interpersonal relationship and innovativeness and students' academic achievement in agricultural entrepreneurial subjects in Senior Secondary Certificate Examination in Niger State. Two research questions and two null hypotheses guided the study. The study adopted a correlational research design and was carried out in Niger State. The target population of the study was all the 151 agricultural teachers from a total of 217 Senior Secondary Schools in Niger State. Purposive Population Sampling Technique was used to select the 151 agricultural teachers in Senior Secondary Schools in Niger State, because the population was manageable. The instrument for data collection was a structured questionnaire titled: Agricultural Entrepreneurial Subjects Teachers' Characteristics Questionnaire (AESTCQ) developed by the researchers. It was a 4-point rating scale of strongly agreed (SA), Agreed (A), Disagreed (D) and Strongly Disagreed (SD) with numeric values of 4, 3, 2 and 1 respectively. The Cronbach's Alpha coefficient of the instrument was found to be 0.82. The data for the study was analyzed using and Pearson Product Moment Correlation (PPMC) and Regression Analysis. Findings of the study revealed a positive and significant relationship between the variables and the academic achievement of agricultural entrepreneurial subject students in secondary school certificate examination in Niger State. The study therefore recommended amongst others that, government should develop a framework for enhancing the innovativeness of teachers so as to improve the academic achievement of agricultural entrepreneurial subject students.

Keywords: Interpersonal Relationship, Innovativeness, Students' Academic Achievement, Agricultural Entrepreneurial Subject

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INTRODUCTION

A teacher is a person who helps students to acquire knowledge, skills attitude and idea in any field of study. He is someone who has undergone the necessary and recommended training in teaching preparatory programs and is charged with the full responsibility of imparting knowledge in such a way that it enhances the learning behaviour of the students. Akinsolu (2010) is of the view that teachers are vital pre-requisite for student attainment of educational goal as well as their performance in school subject. Teachers play a crucial role in educational attainment as they are responsible for translating policy into action and principles based on practice during interaction with students (Schön, 2017). The teacher is an essential element in the teaching and learning process. What he does or does not do affect learning. The teacher is the key factor in whether or not students learn well, also the most powerful person in the classroom. Okemakinde, Alabi and Adewuyi (2013) stressed that teachers influence is always felt in every aspect of the society and this illustrates the pivotal position teachers occupy in the society. Teacher's power is such that even when he does nothing, he does something to the class. He has an effect on the class when he is not present. Duse and Ogbha (2013) opined that teachers touch lives of learners with varying ability levels, including those with significant disadvantages.

According to Cook (2016) education cannot be provided by just anybody, it requires a teacher who plans and delivers the lesson or instruction in such a way that objectives can be achieved. Teaching and learning of agricultural entrepreneurial subjects depend to a large extent on teacher's knowledge of the subjects and ability to adequately deliver the instruction to students. Nilson (2016) pointed out that teachers deserve neither all the credit for success nor all the blame for failures because many factors affect students, yet numerous research studies pointed to the importance of the teacher in the classroom in relationship to student performance. Schön (2017) stated that teachers are ultimately responsible for translating policy into action, if the teacher is ineffective, it might affect the performance of students. Owolabi (2007) was also of the opinion that government should find all possible means to retain veteran and experienced teachers who are still willing to serve so that they can contribute their wealth of experience to improving the system of education.

When teachers form positive bonds with students, classroom becomes supportive space in which students can engage in academically and socially productive ways (Modi, 2015). Teacher-student relationship affects early academic and social outcomes as well as future academic outcome. Bazier (2015) reported that the most frequently mentioned qualities of effective teacher are: subject-matter mastery, dedication, cooperation, and sense of humor, creativity, efficiency, and self-control, and discipline, standard, promptness with reports methods and generosity with personal time with students. Noddings (2015)reported that essential characteristics of a good teacher are; knowledge of the subject matter, leadership character, personality, commitment to teaching, confidence, ability to cooperate intelligence, emotional maturity, physical abilities and programme evaluation. These qualities are geared towards making a significant impact on the lives of the student.

Students' ability to connect with their teachers is one attribute that can make a great difference in students' learning achievement. Nwachukwu (2016) defined the student-teacher relationship, as "emotions-based experiences that emerge out of teachers' on-going interactions with their students." When students feel that their teachers are supportive, trustworthy people, they tend to create a connection with their teacher and start to see their teachers as someone who is there to protect them and give them all the chance to enhance their learning and at the same time behave well. When social and psychological relationships with students are established, it creates a positive relationship and also promotes social development and self-esteem among students. When a student perceive that he is welcomed and wanted in the classroom, he is more likely to be engaged and motivated, thus the role the teacher plays in classroom affect the perception the student has on the relationship and classroom environment, which ultimately contribute to academic achievement. Hence, healthy teacher–student interpersonal relationships set a prerequisite for students to engage in learning activities (Tomlinson, 2014). Almost everyone has experienced different interpersonal teacher's behavior, some teachers are distant and others sociable, some are well-organized and others chaotic. In a collective society like Indonesia, interpersonal closeness, represented by the substantial contact among individuals in their daily lives, is highly valued.

In order to develop trusting relationships with students and foster emotional intelligence in the classroom, teachers must first acknowledge that students need to believe in them. If students believe in their teacher, they will trust their teacher. Consequently, trust and belief need to be reciprocated by the teacher, who must in turn 'genuinely' care for the students. Teachers must also be prepared to not present themselves as superior beings destined to treat their students like their subjects. Developing good relationships with students will help them in all areas of learning. According to Noddings (2015), teachers need to develop caring relationships with their students in order to develop an in-depth understanding of their learning needs and abilities. Building genuine trustworthy relationships between teachers and students is pivotal in student capacity to learn (Bradford and Braaten, 2018). Stronge (2018) suggest that if we teach

our students the strategies they need to promote self-regulation of emotions, then they will develop the emotional competence and skills that they require to succeed in their personal, social, and academic lives. When students know that their teacher has their best interest at heart, it will respond to their actions and reactions in a fair and consistent manner which will also show in their performance.

Juma (2016) defines innovation as things, ideas, or practices perceived as new by the population that the innovation is introduced. Besides, “innovation” means both the creative process and the product itself. At the same time, “innovation” can be defined as the process of cognitive state of the person adopting the innovation, and becoming a part of behavioral repertoire (Reader, Morand-Ferron and Flynn, 2016). Innovativeness can be seen in two forms in the literature; individual and institutional. Individual innovativeness is defined as being willing to experience new things, take risks, and be open to experience in terms of character (Burrelland Cooper, 2015). The essence of individual innovativeness is the uniqueness of the intellectual picture of the individual in nature. In other words, innovators’ interpretation of what is happening in the unique view, understanding and reality surrounding them is the key to scientifically understand individual innovation (Kincheloe, 2018). Innovative teachers encourage students to recognize and discover their potential, whereas setting high standards for student learning. Teachers can play innovative roles in their classes depending on their characteristics.

Statement of the Problem

In a bid to bring about educational development capable of fostering national development, huge resources have been spent on education, agricultural entrepreneurship subjects inclusive. Unfortunately, these efforts are yet to yield the desired outcome. Lawal and Adejuwon (2014) reported that students of agricultural entrepreneurship subjects perform poorly in National Examinations conducted by West African Examinations Council and National Examinations Council. For instance, statistics over the past five years from 2014 -2018 corroborated this: the results show that students of animal husbandry in Niger State recorded 15.37% in 2014, 56.92% in 2015, 42.51% in 2016, 55.73% in 2017 and 40.54% in 2018 pass level (NECO, 2018). In the same vein, students of fishery in Niger state recorded 72.93% in 2014, 78.97% in 2015, 64.43% in 2016, 66.92% in 2017and 60.13% in 2018 pass level (NECO, 2018).

Since teacher is the key implementer of the curriculum and controls what goes on in the classroom, from the result above, it is of concern because good results are expected from students after investing heavily in secondary school education. According to Borgen and Hjardemaal (2017) students’ academic achievement in agricultural entrepreneurial subjects is a function of productivity of the teachers handling the subjects. Teacher characteristics such as qualification, teaching experience, age, gender, interpersonal relationship with students, attitude and innovativeness among other things determine his productivity. Bamidele and Adekola (2017) reported that teacher characteristics have been identified to play significant role in students’ academic achievement. However, Atherton(2003) noted that student academic achievement is dependent on several factors namely; teaching method, guidance, availability of facilities, method of testing, background, organization, motivation and opportunity. Adu and Olatundun (2007) stressed that teacher characteristics are strong determinants of students’ academic achievement in schools. They also reported that teacher characteristics can influence student academic achievement and can make great difference in secondary school education. Ibe, Nworgu and Ayaegbunam (2016) noted that there can be no quality education without equipped, prepared and motivated teachers who possess the pedagogical skills, teaching method, attitude, work ethics, responsibilities and interpersonal relationship. These are some of the teacher characteristics that are capable of setting up a situation in which learners can learn effectively towards improving their academic achievement in the subject area. Despite efforts made to improve it, poor academic achievement still persists, therefore, the inconsistency in the academic achievement of students of agricultural entrepreneurial subjects in Niger state could have a link to teacher characteristics and so is worth investigating. Hence the problem of this study is to determine if there is a relationship between teacher interpersonal relationship and innovativeness and the student’s academic achievement in agricultural entrepreneurial subjects in senior secondary school certificate examination in Niger state

Purpose of the Study

The study determined the relationship between teacher interpersonal relationship and innovativeness and students’ academic achievement in agricultural entrepreneurial subjects in Senior Secondary Certificate Examination in Niger State. Specifically, the study determined the relationship between: -

1. Interpersonal relationship of teachers and the academic achievement of students of agricultural entrepreneurial subjects in SSCE.
2. Innovativeness of teachers and the academic achievement of students of agricultural entrepreneurial subjects in SSCE.

Research Questions

The study provided answers to the following research questions:

1. What is the relationship between interpersonal relationship of teachers and the academic achievement of student of agricultural entrepreneurial subjects in SSCE in Niger State?
2. What is the relationship between innovativeness of teachers and the academic achievement of students of agricultural entrepreneurial subjects in SSCE in Niger State?

Hypotheses

The study tested the following hypotheses at 0.05 level of significance:

HO_1: There is no significant relationship between interpersonal relationship of teachers and the academic achievement of students of agricultural entrepreneurial subjects in SSCE in Niger State.
HO_2: There is no significant relationship between innovativeness of teachers and the academic achievement of students of agricultural entrepreneurial subjects in SSCE in Niger State.

METHODOLOGY

Correlational research design was used for this study. The study was conducted in Niger State, which is located in the North Central Zone of Nigeria. The target population of the study was all the 151agricultural entrepreneurial subjects teachers from a total of 217 Senior Secondary Schools in Niger State. Purposive Population Sampling Technique was used to select the 151 agricultural entrepreneurial subjects teachers in Senior Secondary Schools in Niger State, because the population was manageable. The instrument for data collection was a structured questionnaire titled: Agricultural Entrepreneurial Subjects Teachers' Characteristics Questionnaire (AESTCQ) developed by the researchers. It was a 4-point rating scale of strongly agreed (SA), Agreed (A), Disagreed (D) and Strongly Disagreed (SD) with numeric values of 4, 3, 2 and 1 respectively, and was used to elicit information on teacher characteristics. Face validity of the instrument was established by experts in agricultural entrepreneurial subjects. Two lecturers of Agricultural Technology Education in Vocational Education Department, Moddibo Adama University Yola and a teacher of agricultural entrepreneurial subject in public secondary school in Minna, Niger state. The reliability of the questionnaire was ascertained by administering it to 15 agricultural entrepreneurial subjects teachers in Kaduna North and Kaduna South Local Government areas. The Cronbach's Alpha coefficient of the instruments was found to be 0.82. The data for the study was analyzed using and Pearson Product Moment Correlation (PPMC) and Regression Analysis. PPMC was used to answer all the research questions and Regression analysis was used to test the null hypotheses at 0.05 level of significance.

RESULTS

Research Question One: What is the relationship between interpersonal relationship of teachers and the academic achievement of student of agricultural entrepreneurial subjects in SSCE in Niger State?

Table 1: Pearson Product Moment Correlation for the Test of Relationship between Teachers' Interpersonal Relationship and the Academic Achievement of Students of Agricultural Entrepreneurial Subjects in SSCE in Niger State

Variables		Academic Achievement	Interpersonal Relationship
Interpersonal	Pearson Correlation	.863**	1
Relationship	N	151	151
Academic	Pearson Correlation	1	.863**
Achievement	N	381	151

Table 1 shows the Pearson product moment correlation for the test of relationship between teachers' interpersonal relationship and the academic achievement of students of agricultural entrepreneurial subjects in SSCE in Niger State. The result shows that, the correlation coefficient between teachers' interpersonal relationship and the academic achievement of students of agricultural entrepreneurial subjects in SSCE is .863. This indicates high positive relationship between teachers' interpersonal relationship and the academic achievement of students of agricultural entrepreneurial subjects in SSCE in Niger State. The high positive relationship implied that, teachers' interpersonal relationship plays an important role in determining the academic achievement of students of agricultural entrepreneurial subjects in SSCE in Niger State.

Research Question Two: What is the relationship between innovativeness of teachers and the academic achievement of students of agricultural entrepreneurial subjects in SSCE in Niger State?

Table 2: Pearson Product Moment Correlation for the Test of Relationship between Teachers' Innovativeness and the Academic Achievement of Students of Agricultural Entrepreneurial Subjects in SSCE in Niger State

Variables		Academic Achievement	Teachers' Innovativeness
Teachers'	Pearson Correlation	.865**	1
Innovativeness	N	151	151
Academic	Pearson Correlation	1	.865**
Achievement	N	381	151

Table 2 shows the Pearson product moment correlation for the test of relationship between teachers' innovativeness and the academic achievement of students of agricultural entrepreneurial subjects in SSCE in Niger State. The correlation value of .865 was obtained for the relationship between teachers' innovativeness and the academic achievement of students of agricultural entrepreneurial subjects in SSCE. This value indicated that, there is high positive association between teachers' innovativeness and the academic achievement of students of agricultural entrepreneurial subjects in SSCE in Niger State. The high positive relationship implied that, the academic achievement of students of agricultural entrepreneurial subjects in SSCE in Niger State is positively influenced by teachers' innovativeness.

Hypothesis One

HO_1: There is no significant relationship between interpersonal relationship of teachers and the academic achievement of students of agricultural entrepreneurial subjects in SSCE in Niger State.

Table 3: Regression Analysis for the Test of Significant Relationship between Teachers' Interpersonal Relationship and Students Academic Achievement in Agricultural Entrepreneurial Subjects in SSCE in Niger State

Model	Unstandardized coefficient		Standardized coefficient	R square	T	Sig
	B	Std.error	Beta			
Interpersonal relationship	2.003	.096			20.848	.000**
			.863	.745*		
Academic achievement	-1.070	.0311			-3.441	.001

Table 3 reveals the regression analysis for the test of significant relationship between teachers' interpersonal relationship and students academic achievement in agricultural entrepreneurial subjects in SSCE in Niger State. The result displayed that, the significant criterion (sig.) or p-value was.000 which is less than the confidence level of 0.05.

The result highlighted that, there is statistically significant relationship between teachers' interpersonal relationship and students academic achievement in agricultural entrepreneurial subjects in SSCE in Niger State. Therefore, the null hypothesis of no significant relationship between teacher's interpersonal relationship and the academic achievement of students of agricultural entrepreneurial subjects in SSCE in Niger Statewas rejected. Moreover, the result also made known, the coefficient of determination (R square) as .745. This concluded that, 74.5% of the variation in students academic achievement in agricultural entrepreneurial subjects in SSCE in Niger State is attached with teachers' interpersonal relationship.

Hypothesis Two

HO_2: There is no significant relationship between innovativeness of teachers and the academic achievement of students of agricultural entrepreneurial subjects in SSCE in Niger State.

Table 4: Regression Analysis for the Test of Significant Relationship between Teachers' Innovativeness and Students Academic Achievement in Agricultural Entrepreneurial Subjects in SSCE in Niger State

Model	Unstandardized coefficient		Standardized coefficient	R square	T	Sig
	B	Std.error	Beta			
Teachers' innovativeness	1.788	.085			21.028	.000**
			.865	.748*		
Academic achievement	-.251	.272			-.930	.354

Table 4 shows the regression analysis for the test of significant relationship between teachers' innovativeness and students academic achievement in agricultural entrepreneurial subjects in SSCE in Niger State. The analysis showed that, the significant criterion (sig.) or p-value was.000 which is less than the confidence level of 0.05. The result highlighted that, there is statistically significant relationship between teachers' innovativeness and students academic achievement in agricultural entrepreneurial subjects in SSCE in Niger State. Hence, the null hypothesis of no significant relationship between teacher's innovativeness and the academic achievement of students of agricultural entrepreneurial subjects in SSCE in Niger Statewas rejected. Furthermore, the result also shown that, the coefficient of determination (R square) was .748. This inferred that, 74.8% of the variation in students academic achievement in agricultural entrepreneurial subjects in SSCE in Niger State was accounted for by teachers' innovativeness.

Discussion of Findings

Findings from the study revealed that there is a positive relationship between the interpersonal relationship of teachers and the academic achievement of students of agricultural entrepreneurial subjects in SSCE in Niger State. The hypothesis that was tested also indicated that there is a significant relationship between teachers' interpersonal relationship and the academic achievement of students of agricultural entrepreneurial subjects in SSCE. It implies that as they access new ideas, experiences and exposures and put them to use, the students they teach are better off and so perform better in SSCE. This was buttressed by the findings made byFan (2012) and Ibe, Nworgu and Ayaebunam (2016) who reported that teachers' interpersonal relationship significantly influence students achievement in Biology. This is not farfetched because, teachers who are sociable and relate well with their colleagues, have greater tendency to access new ideas, experiences and exposure which the formal training they went through may not give them. In addition, teachers who have high interpersonal relationship skills, are accessible to their students and have the opportunity to understand his students better. A situation that enables him to tailor his lessons in a way that meet their individual needs, and thereby helping the students to achieve better performance levels in internal and external examinations.

Also, the findings of the study revealed that the innovativeness of teachers has a positive relationship with the academic achievement of students of agricultural entrepreneurial subjects in SSCE in Niger State. In the same vein, the null hypothesis that was tested at a p-level of 0.05 revealed that there is a significant relationship between teachers' innovativeness and the academic achievement of students of agricultural entrepreneurial subjects in SSCE. This means that the more a teacher is innovative the better is his output and so the academic achievement of his students in agricultural entrepreneurial subjects. This position is corroborated by Parlar and Cansoy (2017) who found out a positive significant relationship between the individual innovativeness characteristics of openness to experience and opinion-leading, and teacher professionalism. Additionally, Vasudevan (2013) who studied the influence of teachers' creativity, attitude and commitment on students' proficiency of the English Language, reported that creative thinking, creative learning, creative teaching, teachers' attitude and teachers' commitment positively and significantly influence students' proficiency in English language. This does not come as a surprise because innovativeness (creativity) takes care of a teacher's willingness and openness to adopt new ideas with a view of effecting a change in the existing situation (Parlar & Cansoy, 2017). Adopting new ideas and the willingness to take change to a higher degree has over time enabled teachers give their students the extra push that has enabled them achieve better results in school subjects especially in agricultural entrepreneurial subjects.

CONCLUSION

The academic achievement of students in agricultural entrepreneurial subjects in senior secondary schools across the country is an important aspect of the economic development of the nation. This is because it is one of the means of appropriately reporting whether or not the classroom instructional activities are being effectively carried out. Some of the factors that affect the output, as found by this study, are teacher characteristics such as innovativeness and interpersonal relationship. This study found a positive and significant relationship between the variables and the academic achievement of agricultural entrepreneurial subjects' students in secondary school certificate examination in Niger State. In essence, the academic achievement of agricultural entrepreneurial subjects students in secondary school certificate examination in Niger State is enhanced when the teachers that are teaching the subjects have good innovative aptitude and optimum interpersonal relationship skills.

RECOMMENDATIONS

Based on the findings of the research the following recommendations were made:

1. Conferences, workshops and seminars on building interpersonal relationship skills should be periodically organized for teachers in order to help boost their productivity.
2. The government should develop a framework for enhancing the innovativeness of teachers so as to improve the academic achievement of agricultural entrepreneurial subjects students.

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Full Length Research

Comparative Study of Electronic Information Resources Usage in Public and Private Universities.

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The study was carried out to examine comparative study of electronic information resources usage in public and private universities. The study was guided by five research questions and four null hypotheses formulated and tested at 0.05 level of significance. The study adopted comparative research design, the population of the study was 8,563 comprising 2,524 undergraduates' in two Public Universities and two Private Universities and 6,039 undergraduates in Anambra State, Nigeria. The Universities used for the Study are NnamdiAzikiwe University, Awka; Chukwuemka Odumegwu Ojukwu University, Ul/Igbariam;Legacy University Okija; and Paul University, Awka. The sample of this study was 428 comprising 302 undergraduate students in public universities and 126 undergraduate students in private universities. The instrument for data collection was researcher designed questionnaire titled "Undergraduates' Use of Electronic Information Resources Questionnaire (UUEIRQ)". The instrument were validated by four lecturers, one from each university. The reliability of the instrument was 0.79 which was determined using Cronbach Alpha statistic. The data were collected through the administration of 428 copies of the questionnaire to respondents and 405 copies were retrieved completely filled and used for data analyses representing 95% rate of returns which include: 284 public and 121 private university students. The research questions were answered using frequency count, percentages, mean and standard deviation and the null hypotheses were tested using the t-test statistic. The result of the data analyses revealed that: Undergraduate students to a high extent access EIRs in private university libraries and low extent in public university libraries. The undergraduate students to a high extent utilized EIRs in private university library and to a low extent in public university libraries. The challenges of the use of EIRs among undergraduate students in public and private university libraries include: unfriendly user interface, inadequate electronic information gadgets, and slow internet network connectivity among others. From the findings,recommendations were made.

Keywords: Electronic Information Resources, Usage, Public Private, and Universities

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INTRODUCTION

Information is the life–wire of any developed society most especially the university environment and its utilization is as old as man. Information technology has a great influence in all aspects of librarianship and information service delivery. The evolution of information technology in the 21st century has influenced undergraduate students' use of information resources. Today, many students access information electronically through the Internet using desktop, laptop, palmtop and mobile phones. Electronic information resources supply all the information that a library provides through computer network. These include electronic journals, books, databases, library web pages articles from magazines, bibliographies,

encyclopedias, pamphlets among other resources that are accessed on electronic media (Biokuromoye, Victor & Ebhomeya, 2014).

Electronic information resources (EIR) refer to those materials that require computer access, whether through a personal computer, mainframe, or handheld mobile devices in order to disseminate information. They may either be accessed remotely via the Internet or locally (International Federation of Library Associations and Institutions (IFLA), 2012). Dhanavandan and Tamizhchelva (2012). It is also define an electronic information resource as a resource which requires computer access or any electronic product that delivers a collection of data, be it text referring to full text basis, electronic journals, image collections, other multimedia products and numerical, graphical or time based, as a commercially available title that has been published with an aim to being marketed. These may be delivered on CD ROM, on tape, via Internet. A number of techniques about related standards have been developed which allow documents to be created and distributed in electronic form. IFLA (2012) in support of the above definition, defines electronic resource as any work encoded and made available for access through the use of a computer. It include electronic data available by remote access and direct access (fixed media). In other words; remote access (electronic resources) refers to the use of electronic resources via computer networks. Direct Access (electronic resources) refers to the use of electronic resources via carriers (discs/disks, cassettes, cartridges) designed to be inserted into a computerized device or its auxiliary equipment.

Recent technologies have enabled new forms of handling information and have created more dynamic and flexible tools for managing and making it accessible than the print formats. This has created a major shift from the traditional set up of library which focuses on the physical collection of information resources, to a stage where information is predominantly stored in digital formats. This advancement has caused changes both in the way users' access information and the way libraries provide and manage resources. (Luka, 2015). Electronic information resources (EIR) are information materials in the library that can only be accessed electronically, with the use of Information and Communication Technology (ICT) facilities (Ukachi, 2013). Electronic information resources that are often consulted in the University libraries include: Internet, CD-ROM databases, online databases, Online Public Access Catalogues (OPACs), electronic journals, electronic books and digitized materials. Multiple access speed, richer in content, reuse, timeliness and anywhere access are some of the features of electronic information resources. Electronic information resources according to Ani, Ngulube and Onyancha (2014) are simply referred to as electronic resources or e-resources; they are information stored in electronic format in computer or computer related facilities (CD-ROMs, digital libraries or the Internet). The use of electronic information resources is a factor that considers largelythe influence in the nature of electronic information environment that is available by the state of ICT in a given University.

Therefore availability and use of EIRs is vital in enhancing students' academic work. Thus, Obande and Abdulsalami (2020) define use as an act or instance of making practical or application of something for a given purpose. It is also describe as to put or bring into action or service or apply to a given purpose. In the context of this study, use can be described as adoption of EIRs by undergraduates in university libraries for academic purposes.

In recent time, there has been the need of electronic information resources (EIRs) in university libraries to meet up with the objective of their parent institutions. Electronic information resources are invaluable tools for study, learning and research (Togia and Tsigilis, 2009). For any university library to thrive in this information age, the library irrespective of the size of its collection must embrace Information Communication Technology. Online dictionary of library and information science (2014) defines electronic information resources as materials consisting of data and/or computer program(s) encoded for reading and manipulation by a computer, such as a CD-Rom drive or remotely via network such as the Internet by use of a peripheral device directly connected to the computer. In this present day and age, information retrieval and dissemination has improved drastically with the help of information, communication and technology (ICT). Hence, users do not necessarily come physically to the library to use the print resources (e.g. books, journals, magazine, etc) but they can access these same resources in electronic form via the Internet in their offices, homes, schools, etc. With advances in ICT and e-publishing, online databases, such as Emerald insight, Ebscohost, TEEEL, Science Direct, OARE Sciences, HINARI, Academic Search Premier, online public access catalogue (OPAC), CD-ROMs, , e-journals, e-books collections on various subjects and so on can be accessed and help overcome the usual barriers of accessibility, time and space (Prangya & Rabindra, 2013; Sharma, 2009).

According to Ayeni, Omoba, Tella and Tella (2007), electronic information resources have many roles and benefits that can positively impact performance of students and researchers in the university as well as other advanced institutions of learning. It is important that students are familiar with the use of electronic information resources for faster and more efficient use of the library. It is evident that electronic information resources facilitate the libraries to get the benefits of large number of resources at an affordable cost and in minimal time. Moreover, the technology has changed the expectations of users, their patience, and their willingness to accept services that are available on demand worldwide. Electronic information resources are the answer to the expectations of the users (Ani, 2013). Electronic information resources use, no doubt, has myriad advantages for libraries as users/undergraduate students now access

information resources across the globe without restriction which was practically impossible in the past.

University library is one of the libraries categorized under academic libraries in institutions of higher learning. The term university library, according to Edoka, in Edem and Egbe (2016), is a generic name used to refer to all libraries located in universities. It also refers to as the bosom of the university using the material and human resources at its disposal to support teaching, learning and research objectives of the institution both in public and private universities.Public university libraries are the libraries found in public university environment to serve the university community. These libraries are established and funded by governments. The public university libraries are established to provide relevant information and quality services necessary for sustaining teaching, learning and research activities in realization of its role as the only place which can take care of students as well as teachers regarding to their educational needs in the public universities (Akwang, 2013).

Similarly, private university libraries are simply those libraries established in the private universities to support teaching, learning and research. These universities are established by individuals, groups, church and private organizations whose funding comes from tuition, investments, and private donors, not from taxpayers. The private university libraries stock a wide range of print and non-print resources on various discipline offered in the university (Udoh, 2012). This implies that university libraries with the available resources and service provide opportunity to all students, lecturers, researchers and non-teaching staff to meet their information needs manually or computerized (Abinew & Vuda, 2013).

University library computerization has greatly influenced the way information is being used. Libraries and information centers are becoming more attractive as a result of Information and Communication Technologies (ICTs) that have broken every barrier that hinders access to information. Abinew and Vuda (2013) opine that libraries have transformed into digital and virtual libraries where books, journals and magazines have changed into e-books, e-journals, and e-magazines. This has increased the global dissemination of information.

Undergraduates are students, male and female in tertiary institutions undergoing courses in different disciplines to obtain bachelor's degree. In this context, tertiary institutions are universities which are the focus of this research. The undergraduates learn as well as carryout research as one of the requirements for the courses they offer. For effective learning and research, university library serves the undergraduates' relevant information in electronic format. They use the relevant information for class assignments, seminars, term papers and projects. The undergraduates also use information to satisfy their social and psychological needs as well as recreation or leisure purpose.Hence, the need to examine comparative study of electronic information resources usage in public and private universities in Anambra State, Nigeria.

Hypotheses

The following null hypotheses were formulated and tested at 0.05 level of significance:

H01: There is no significant difference between the mean responses of undergraduate students of public and private universities on the extent students access electronic information resources.
H02: There is no significant difference between the mean responses of undergraduate students of public and private universities on the extent to which students use electronic information resources.
H03: There is no significant difference between the mean responses of undergraduate students of public and private universities on the challenges of the use of electronic information resources.

Review of Related Literature

The various types of electronic information resources in university libraries such as electronic books, journals, online database, CD ROOM database, digital institutional repository, digital library and virtual libraries are discussed below:

Electronic books: Libraries now provides access to a variety of electronic books, as well as the other printed works (such as essays, poems, or historical documents). Some of these electronic books and texts are part of large, searchable databases which enable users (undergraduates) to access books through electronic forms (Quadri, Adetimirin & Idowu, 2014).

Electronic journals: Most of the university libraries now have an offline e-Journals Database to help you find journal materials that are useful to users and an online version of e-journals which the library subscribe to have access to current journal publication (Ankrah & Atuase, 2018).

Online database: Is a web-based filing system designed to store information. It is a database accessible from a network, including from the Internet. Most university libraries subscribe to online databases of books and journals that are relevant to the university curriculum which will help to facilitate teaching and learning in the university environment (Ankrah & Atuase, 2018).

Online sources: These are materials that are available online. It can be an online magazine or newspaper, television website such as NBC or CNN. Peer-reviewed journals, webpages, forums and blogs are also online sources. Some other names for online sources are 'electronic' sources, 'web' sources and 'internet' sources. These are very useful electronic information resources which many libraries are now making available to satisfy the urgent needs of their user community (Omeluzor, Saturday & Ogo, 2018).

CD-ROM database: The name is an acronym for "Compact Disc Read-Only Memory". This implies that computers can read CD-ROMs, but cannot write on the CD-ROMs which are not writable or erasable. Until the mid-2000s, CD-ROMs were popularly used to distribute software for computers and video game consoles. Some CDs, called enhanced CDs, hold both computer data and audio with the latter capable of being played on a CD player, while data (such as software or digital video) is only usable on a computer which university now used to store valuable data for use by the librarians or library users (Amankwah, 2014).

Digital institutional repository: Is an institutional repositories digital collections used in capturing and preserving the intellectual output of a single or multi-university community which provide a compelling response to strategic issues facing academic institutions. Joseph (2014), explains that “this is an online, searchable, web-accessible database containing intellectual works by scholars and researchers organized to increase access to scholarship and ensure their long term preservation.

Digital library: This library may be perceived as an information service or a collection of electronic information resources, in which all the information resources are available in computer process able form. Mutula and Ojedokun (2016) identify examples of digital libraries to include; Bartleby Library, Great Books Online (http://www.bartleby.com), Library of Congress (http://www.loc.gov) and New York Public Library (http://digital.nypl.org).

Virtual libraries: These librariesrefer to an information service or collection of electronic resources whose collections are entirely in virtual or digital form and information is accessed over a network. Such a library provides access to virtual indexes, catalogues, and books. These types of libraries do not have physical space, where users visit to access information resources (Amankwah, 2014).

The advent of electronic information resources has been a blessing to libraries and information centers. According to Schutte (2014), utilization of electronic information resources and services has led to the shift from an emphasis on the book and journal collection to an emphasis on information services. Use of EIRs affords researchers and undergraduates the opportunity to have access to global information resources, especially the Internet for their school work. Undergraduate students in university libraries make use of EIRs for many purposes mostly for academic purposes that is, retrieving current literature for studies and preparing for examinations, doing class assignments, carrying out research projects, and communicating and collaborating with peers and teachers via the Internet on e-mail or by following blog discussions (Adeniran, 2013). Undergraduate students use e-books and e-journal articles to acquire knowledge and carry out research work (Ajayi, Shorunke & Aboyade, 2014).Course materials are provided on CD-ROM for students’ use which helps them to use EIR at their convenient time. With the emergence of ICT, EIRs have become widely used and accepted among undergraduates and have increased tremendously in volume around the globe (Oyedapo &Ojo, 2013). All these resources have really improved the quality of education as this is evident in the literature.

However, literature has revealed low usage of EIRs by undergraduates in Nigeria (Omoike, 2013).The uses of EIRs have become necessary in the academic environment as they serve as motivating factors to users by providing opportunities to share, acquire, transfer and disseminate information on any subject of concern. Electronic information resources provision makes it possible for users to access new tools and applications for information seeking and retrieval. E-resources have become invaluable research tools that complement the print collection in the traditional library setting.

OPAC is another EIR used by undergraduates as means of getting access to library collection. With OPAC, library undergraduates can locate information resources they need in the library easily. It improves searching capabilities of the library resources because information resources can be located as easy as possible compared to the traditional card catalogue. With the help of OPAC, undergraduates can browse online the physical collection of the library anywhere

regardless of their geographical location(Obuh, 2011). Thus, this initiative has saved their time and cost of travelling from their remote locations and reduce the number of physical presence in the library. Therefore, by using the library OPAC, students can access bibliographical records of variety of information resources independently without looking for assistance from the library staff or a colleague and without being necessarily present in the library since they can access it from their remote locations using computer, Ipad, smart phones or other electronic devices(Obuh, 2011).

The manual system of searching for information resources does not permit multiple access and usage of the same information resources by different users unlike online services. It is worthy of note that, EIRs are of great importance to the academic and research needs of undergraduate students in university libraries since they are available in various formats (Fabunmi, Paris &Fabunmi, 2016).

In the same vein, due to the several advantages of EIRs such as their timeliness, search facilities, remote access and up-datedness, they have become more indispensable after the arrival of the Internet in the academic environment. The provision of EIRs in tertiary institutions of learning is a new way of gaining quick access to a great number of research information globally (Aina, Okunnu, & Dapo-Asaju, 2014). As a result of the potential benefits offered, they have been embraced by university libraries. Undergraduates would benefit from the EIRs if they are well harnessed as they will provide excellent opportunities to access scholarly information which are beyond the reach of libraries due to geographical barriers and limited finances.

Use of Electronic information resources (EIRs) has become inevitable for undergraduates in the digital age, given the volume of academic materials that are available in EIRs. Even though university libraries conduct workshops and seminars to sensitize undergraduate students on the use of electronic information resources that are available in Ahmadu Bello University library, the literature has established that their use by undergraduate students have been very low (Aina, Okunnu, & Dapo-Asaju, 2014).

It is important to note at this point that the undergraduates in the universities today use electronic information resources and services much more than any other category of library users in the university. This is because they are more computer literate, considering the impact of the computer age on them (Oyedeji, 2016). This is supported by Scoyoc and Cason (2016) that the vast majority of undergraduates of all categories turn to the computer services like the Internet for their academic works. Schayan (2017) states that “the way undergraduates who were once used to read through books page by page have now turned to the Internet for their academic needs is unimaginable. Ezeji (2018) maintains that undergraduates of all categories in one way or the other use computer and other electronic information resources for their academic work.

Students in universities find electronic information resources useful because they are time saving. Adomi, Omodeko and Otolo (2014) assert that students have to access the Internet to supplement notes given to them by lecturers, to complete class assignment, write the project and to communicate via e-mail. In this regard, Temopir (2015) opined that it is clear that there is increase in the use and services of electronic information resources because of the advancement in technology and vast development of information resource all over the world.

METHODOLOGY

The design of the study was comparative research design. Anaekwe (2002) states that comparative research design is concern with comparing two groups in an attempt to draw a conclusion. The comparative research design is chosen because it enable the researcher to collect and describe systematically the data on undergraduates’ use of electronic information resources (EIRs) in public and private university libraries in Anambra State , Nigeria. The Universities used for the Study are Nnamdi Azikiwe University, Awka; Chukwuemka Odumegwu Ojukwu University,Legacy University Okija and Paul University, Awka.The population of the study was 8,563 comprising 6,039 undergraduates in two public universities and 2,524 undergraduates in two private universities,Anambra State , Nigeria. This number consists of duly registered undergraduate students in 2020/2021 academic session in the two public and two private university libraries in Anambra State.

The sample of this study was 428 comprising 302 undergraduate students in public universities and 126 undergraduate students in private universities. This 428 represent 5% of the total population using simple random sampling technique Thus: The sample size represents a percentage of 5% of total population (6,039) of undergraduates. This is supported by Nwanna in Agbonmiewalen (2017) who recommends that when the population runs into few hundred use 40% or more, when several hundred use 20%, when thousand use 10% and when several thousand use 5% or less.

The instrument for this study was questionnaire designed by the researcher and titled: “Undergraduates’ Use of Electronic Information Resources Questionnaire (UUEIRQ). The questionnaire consists of three clusters. Focused on the extent of the accessibility of EIR by undergraduates in public and private university libraries. The questionnaire was

designed based on a four point rating scale and indicated responses strength as follows: Strongly Agree/Very High Extent/ Very Highly Aware (SA/VHE/VHA), Agree/High Extent/Highly Aware (A/HE/HA), Disagree/Low Extent/Lowly Aware (D/LE/LA) and Strongly Disagree/Very Low Extent/Very Lowly Aware (SD/VLE).

The three hypotheses were tested using t-test analysis technique at 0.05 level of significance. The null hypotheses were accepted if the t-calculated value is less than the t-table value at 0.05 level of significance and rejected if the t-calculated value is greater than the t-table value at 0.05 level of significance. The choice of this statistical tool (t-test) to test the research hypotheses is because it shows the mean difference between the public and private university libraries variables.

Results and Discussion

Hypothesis 1

H01: There is no significant difference between the mean responses of undergraduate students of public and private universities on the extent students access electronic information resources.

Table 1: t-test analysis of the mean **responses of** undergraduate students of public and private universities on the extent students access electronic information resources

Variables	N	Mean	S.D	DF	t-calculated	t-critical	Decision
Public Universities	284	2.40	0.96				
				403	-2.38	1.97	**Accepted**
Private University	121	2.78	1.04				

The data in Table 1 shows that the calculated t-value is -2.38 while the t- critical value is 1.97 at 0.05 level of significant and at 403 degree of freedom. Since the t-calculated value is less than the t-critical value, the null hypothesis was upheld. Therefore, there is no significant difference between **the mean responses of** undergraduate students of public and private universities on the extent students access electronic information resources.

Hypothesis two

H02 : There is no significant difference between the mean responses of undergraduate students of in public and private universities on the extent to which students use electronic information resources.

Table 2: t-test analysis of the mean ratings **responses of** undergraduate students of public and private universities on the extent to which students use electronic information resources

Variables	N	Mean	S.D	DF	t-calculated	t-critical	Decision
Public Universities	284	2.38	1.01				
				403	-4.40	1.97	**Accepted**
Private University	121	2.86	1.00				

The data in Table 2 shows that the calculated t-value is -4.40 while the t- critical value is 1.97 at 0.05 level of significant and at 403 degree of freedom. Since the calculated value is less than the t-critical value, the null hypothesis was upheld. Therefore, there is no significant difference **between the mean responses of** undergraduate students of in public and private universities on the extent to which students use electronic information resources.

$H0_3$: There is no significant difference between the mean responses of undergraduate students of public and private universities on the challenges of the use of electronic information resources.

Table 3: t-test analysis of the mean ratings **responses of** undergraduate students of public and private universities on the extent to which students use electronic information resources

Variables	N	Mean	S.D	DF	t-calculated	t-critical	Decision
Public Universities	284	2.73	0.98				
				403	-1.24	1.97	**Accepted**
Private University	121	2.87	1.06				

The data in Table 3 shows that the calculated t-value is -1.24, while the t- critical value is 1.97 at 0.05 level of significant and at 403 degree of freedom. Since the calculated value is less than the t-critical value, the null hypothesis was accepted. Therefore, there is no significant difference **between the mean responses of** undergraduate students of public and private universities on the challenges of the use of electronic information resources.

Discussion of the Findings

The extent undergraduate students' access electronic information resources in public and private university libraries in Anambra State, Nigeria

Table 1 showed that **there is no significant difference between the mean responses of** undergraduate students of public and private universities on the extent students access electronic information resources. This finding is in conformity with the study of Tofi and Fanafa (2019) who found out that, e-journals, e-newspapers, Online Public Access Catalogue (OPAC), CD-Rom database, e-magazines, e-books, online database, e-research reports, virtual library online, science direct online and Ebscohost reference databases were the electronic information resources access by students in Francis Sulemanu Idachaba Library University of Agriculture, Makurdi, Benue State, Nigeria. The finding is also in tandem with the findings of Obande and Abdulsalami (2020)that electronic information resources were accessed by students to a high extent in private universities. Meanwhile, Das (2014) reported that aaccessibility of electronic information resources were on a low extent in University of Agriculture Library, Abeokuta, Nigeria.

The extent undergraduate students' use electronic information resources in public and private university libraries in Anambra State, Nigeria

Table 2 indicated that **there is no significant difference between the mean responses of** undergraduate students of public and private universities on the extent to which students use electronic information resources. The finding of this study relate with the study of Tofi and Fanafa (2019)that, e-journals, e-newspapers, Online Public Access Catalogue (OPAC), CD-Rom database, e-magazines, e-books, online database, e-research reports, virtual library online among others were electronic information resources utilized among students on high extent. The finding is also in line with the finding of Biokuromoye, Victor and Ebhomeya (2014) which revealed that students in Niger Delta University and Rivers State University of Science and Technology (RSUST) use electronic resources but to a low extent as a result of slow internet connectivity.

Challenges of the use of electronic information resources among undergraduate students in public and private university libraries in Anambra State, Nigeria

Table 3 revealed that **there is no significant difference between the mean responses of** undergraduate students of public and private universities on the challenges of the use of electronic information resources. The study of Edem and Egbe (2016) also correspond with the later study on the challenges of the use of electronic information resources among undergraduate studentssuch as lack of computer skills, slow network, inconsistent internet connectivity, power outage and irrelevant electronic information resources were the problems postgraduate students encountered while accessing and using electronic resources in UNICAL Library. The study is also in agreement with Obande and Abdulsalami (2020)which revealed lack of advanced searching skill, navigation problems, library staff indifference, poor internet connectivity, technological constraint, lack of ICT skill, student poor orientation, frequent breakdown of the system, lack of personal laptop and other electronic gadgets, erratic power supply, and lack of awareness and use of electronic information resources by some students as challenges to utilization of electronic information resources.

Conclusion and Recommendations

Based on the results of the findings, it was concluded that, were highly aware, accessed and utilized to a low extent in public universities but high extent in private universities and the challenges of the use of electronic information resources among undergraduate students in public and private university libraries were; unfriendly user interface, inadequate electronic information gadgets, slow internet network connectivity, lack of consistent training of users, inadequate knowledge of electronic information resources, lack of or inadequate information resources, lack of subscription to relevant e-journals, lack of appropriate skills among users and lack of maintenance and poor infrastructure.

Based on the findings of the study, the following recommendations are made:

1. There is need to provide guidance to students for them to have more access to electronic information resources especially in public university libraries where the level of accessibility of electronic information resources is low.
2. Since electronic information resources are used in public universities on a low extent and to higher extent in private universities, efforts should be made by the university administrators and library management in public university libraries to enlighten the students on the needs for them to use electronic information resources.
3. There is also the need for university administrators to double their efforts in order to address the challenges confronting student use of electronic information resources such as improvement of iinternet network connectivity in the university system, provision of adequate electronic information gadgets and other facilities needed for enhancing students use of information resources.

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Full Length Research

Exploring the Practices and Strategies of Active Learning in Higher Education

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Active learning has gained increasing educational, and research interest. Active learning has a broad definition. This paper provides a comprehensive guide for instructors who aim to engage their students in the learning process. It examines the transition from passive to engaging approaches in higher education by examining active learning practices. It uses a mixed-methods approach in universities in the Arab area to collect data through surveys and interviews. The growth of communication skills, planning obstacles, and student engagement are highlighted in the qualitative findings. Active learning's effectiveness is dependent on increasing engagement, as demonstrated by a positive correlation between critical thinking and quantitative analysis conducted with SPSS. Time management and skill regulation are two difficulties. Successful implementation requires careful planning, alternative assessment, and continuous skill development. The study focuses on the significance of institutional support to assist teachers in reaping the benefits of active learning.

Keywords: active learning, Higher Education, Strategies.

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INTRODUCTION

The concepts of teaching and learning have been highlighted in several new studies. According to Harland (2012), a systematic examination of the ideas and pedagogical conditions for their implementations is necessary to achieve the purposes of teaching and achieve what can be done in academic work. In this sense, curriculum refers to the tasks, activities, interactions, and dialogue that take place in the classroom (Sasikumar,2014). Active learning is considered an educational strategy that assists students in applying academic skills, increasing student engagement and improving student critical thinking for students. This research will present and employ numerous active learning strategies in higher education (Vera, 2022). Active learning strategies encourage students to gain and retain knowledge through participation and engagement in the learning process. On the other hand, Traditional or Passive learning focuses on providing students with knowledge through lectures that adversely affect understanding and problem-solving skills (Vera, 2022). Active learning in the classroom has become widely accepted and required to increase the effectiveness of student engagement and sharing of ideas. This can range from small or large groups working together involving discussion, writing, reflection or problem-solving. Vera (2022) indicated that besides the importance of face-to-face interactions between students, recent technology has delivered new opportunities for communication and cooperation outside the physical classroom.

Active Learning Strategies and Implementation

Hartikainen et al. (2019) stated that the processes of active learning are greatly associated with an approach to learning rather than an approach to instruction. Therefore, several strategies of problem-solving, reflective decisions or group discussion can be considered effective strategies for achieving active learning (Vera, 2022). This is crucial as there is a need to consider a shift in the traditional approach when adopting an active learning approach (Arcos-Alonso et al., 2022). Active learning practices can be effectively implemented by adopting different theories including Social learning and Constructivism (Kudryashova et al., 2016). Social learning theory encourages students to work together by providing opportunities for individuals to interact, observe, collaborate and share knowledge. However, constructivism theory allows individuals to construct their understanding by participating, communicating, and engaging in discussions and problem-solving activities. Applying these two theories in higher education is crucial to achieving social and cognitive observation and interaction.

This results in a more successful implementation of active learning processes and enhanced student engagement. The most common strategies to achieve active learning in higher education are: the use of technology, project-based learning, flipped classroom, inquiry-based learning, and collaborative learning (Vera, 2023). To achieve effectiveness in active learning, especially in higher education, academics and practitioners need professional and constant training and development. This can be achieved by organising seminars and training programmes that are vital for improving communication and engaging skills. It is also important for administrators to provide essential resources and tools to academics to assist them in improving their teaching skills and creating a dynamic environment. The students stand to gain the most from this investment in the long run since they get better educational experiences, better academic results, and vital skills that will help them succeed.

Methodology and Sampling

This study employed a mixed-methods approach to collect data including semi-structured interviews and questionnaires with predetermined answers (Lai and Waltman, 2008). This helps in enhancing the quality of the data gathered and ensuring that respondents provide comprehensive responses. The interview was conducted to provide in-depth insights, thoughts and patterns that can assist in establishing the questionnaire. The questionnaire was then designed using the existing literature and the collected data from the qualitative approach. The study selected the top 10 performing universities in the Arab region according to the QS World University Rankings 2024. Qualitative data was collected from 20 academics and highly experienced participants who were then interviewed. The data collected was transcribed and then analysed and themed using content analysis. Finally, quantitative data was collected using a questionnaire distributed to 200 respondents. This data was then analysed using SPSS.

RESULTS

The findings from the interviews provided several patterns and thoughts. This includes student engagement, challenges affecting active learning, planning needed to achieve active learning, authentic assessment, and finally communication skills. The data from the questionnaire assist in providing more in-depth and specific findings. It can be observed that there is a positive relationship between student engagement and critical thinking. Creating more engaged learners are a key goal of active learning approaches.

This approach eliminates the need for students to learn passively through observation. Instead, they take an active approach to a topic that is relevant to their interests and engage in relevant, real-world conversations. This means that improving student engagement is important in achieving effectiveness in active learning. There are some barriers and difficulties that affect the implementation of active learning. These challenges include time management and insufficient regulation skills. Concerning planning, the results stated that there is a need for careful and effective planning when implementing an active learning approach. The results also suggested that moving from traditional assessment to different assessment methods is important to meet the active learning principles. Finally, the results show that there is a need for continuous development of communication skills in terms of written, visual, verbal and nonverbal skills. This leads to achieving effectiveness in an active learning approach and enhances student engagement. To summarize, teachers must possess effective communication skills to build a strong learning community. To create a positive learning environment, teachers can employ crucial communication skills such as active listening, effective questioning, clear and concise language, active engagement, and positive reinforcement. Teachers can foster a positive learning community and help students understand the subject matter better by incorporating communication skills into their teaching methods.

CONCLUSION

In conclusion, active learning is widely regarded as a successful strategy for raising student engagement,

developing critical thinking and problem-solving skills, and fostering the development of general competencies. It is crucial to remember that putting active learning into practice might be difficult. Therefore, participants have to be aware of the challenges and potential obstacles involved in implementing active learning practices in the classroom. If educational institutions want to successfully integrate active learning, they should think about giving teachers assistance, tools, and training. Active learning strategies can be implemented more successfully by practitioners and improve students' educational experiences and outcomes by addressing the obstacles and offering the required assistance. It can be concluded that there is a positive impact of active learning due to its ability to improve a variety of educational facets. Although there are implementation problems, identifying and resolving these issues might help to successfully integrate active learning in the classroom and realise its potential benefits.

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Full Length Research

EFFECT OF ANIMATED BASED INSTRUCTION ON THE PERFORMANCE OF MEDICAL STUDENTSIN GOMBE STATE UNIVERSITY

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The study determined the effect of animated based instruction on the performance of medical students in Gombe State University. Animated visuals in medicine explicitly explain general activity and motion of human body and its organs as instructional aid. The aim of this study is to determine the effect of animated based instruction on the performance of medical students. Non-availability of 3D Interactive Learning triggered the need to carry out a wider research. Quantitative approach (quasi-experimental and descriptive research design) was used to determined pre-performance test of pre-clinical students of medicine, post-performance test and perception of students from medicine and pharmacy on the use of animated visuals as instructional aid. A structured questionnaire was designed for data collection which addressed the perception of the students. The result showed that pre-test performance of the students is below average as indicated by mean value of 48.76 %, and post-test performance of the students is above average as indicated by mean value of 65.45 %, these vindicated that there is significant difference as indicated by t-statistics of 8.102 and p-value of 0.000 are within the recommended threshold of 1.96 minimum and 0.05 maximum respectively, meanwhile, the mean difference is 16.684 % with post-test having the upper scores. The perception of medical students on learning indicated the mean scores of 4.13 to 4.58, while on best mode for teaching anatomy the result indicated mean ranking of 1.30 to 2.22,which showed the students agreed that Animated Based Learning (ABL) is better than traditional didactic learning (TDL); it gives better knowledge of anatomy, it promotes better students participation in learning process, and is more effective in fulfilling learning objectives. Therefore, the study concluded that the intervention of animated based learning for medical students is effective and significant. The study also recommends the Provision of 3D Interactive Learning tools; Medical colleges should have curriculum evaluation mechanism that will embrace dynamics of modern teaching.

Keywords: Effect, Animated Visual, Method of Instruction, Academic Performance,didactic lectures and Medical students

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INTRODUCTION

Teaching and learning are important events in the life of an individual. Teaching is effective when a learner

understands what is being taught (Josh, 2016). According to Sajjad (2013) teaching and learning are the two sides of a coin. The most accepted criterion for measuring good teaching is the amount of student learning that occurs. Medicine may be one of the most interesting and important field of Science, but it is extremely difficult to study. Although, learning a main concept may be sufficient in other disciplines, medical students must learn many details, understand all relevant mechanisms; study hundreds of pages and attempt to remember them forever (Cingi, 2013).

Medical students must also be acclimatized with methods, concepts, and contents from one or more of the humanities' disciplines to investigate illness, pain, disability, suffering, healing, therapeutic relationships, and other aspects of medicine and healthcare practice. With the advent of Technology people now embrace computer aided designs to address problem of traditional teaching (chalk and talk) methods. Proper use of animation can bring into the class inaccessible processes, materials, events, objects, changes in time, speed and space (Kwasu, 2015). A good visual impact is better than the descriptive lectures based on words. Animation is a developing and interesting visual communication instrument; with multipurpose functions such as entertainment, information, advertisement and education (Josh, 2016).

The major limitation of traditional method of teaching is that the listener passively receives the materials and feels bored and sleepy. According to Mayer (2003), there is empirical evidence that the verbal only method does not always work so well. Their research shows, on average, that students who listen to (or read) explanations that are presented solely as words are unable to remember most of the key ideas and experience difficulty in using what was presented to solve new problems.

Animation as instructional tool will make students experience powerful, it will provide the cognitive and emotional impact they need for knowledge retention. Learning is best achieved when a lecture is coupled with a motion picture, because this combination provides a reference point from which students can appreciate the knowledge presented in the motion picture (Paivio, 1991). Animated visuals simulate the actual living situation, thereby making real an otherwise. Students in general confirmed that animations are beneficial to learning, and were a good media to explain concepts more clearly, it improves understanding of the content of topics, they also pointed out that animations were particularly helpful in explaining complicated and dynamic concepts which were otherwise difficult to represent through mere text or static images. In addition, some students became more interested in learning, and admitted that animations facilitated memorizing of content Hwang, *etal.* (2012).

According to Berk (2010) multimedia verbal and visual stimuli increase memory, comprehension, understanding, and deeper learning than either stimulus by itself. Learning in the pictorial conditions tested (video and audiovisual) was superior to learning in the verbal (audio) conditions. A well designed animated visual will enhance learning and improve and facilitate teaching. The expressive, illustrative, descriptive and narrative potentials of the materials will be greatly enhanced.

This research is undertaken on the assertion that current innovations in medical graphics especially animated visuals have positive effect and impact on teaching and learning, as indicated by several studies within and outside Nigeria. Therefore, there is need to conduct this research for medical students in Gombe state university. Adoption of this teaching aid will have strong and positive impact on students because according to Hwang, *etal.* (2012) animated visuals could explain complicated contents more explicitly to students.

Statement of the Problem

Inadequate adoption of new instruction and learning methods in tertiary institutions, like the use of animated visuals as instructional resources paved the way and encouraged the use of traditional teaching and learning methods (Roopashree, Tiwari&Niranjana, 2013). This challenge could be effectively approached through good graphic design input through animations. Studies conducted by Azu and Osinubi, (2011); Abdulraheem, Musa, Oladipo, (2010); Saalu*et al*. (2010); Onasanya. (2002); Yisah.(2008); Onasanya*et al*. (2010); Salisu, (2015); Kwasu and Ema. (2015) indicates the use of animated visuals in teaching; however none of these studies considers undergraduate medical students in Gombe state University.

Purpose of the Study

1. Assess the level of students' pre-performance test towards traditional didactic lectures to medical students in Gombe state university.
2. Determine the level of students' post-performance test towards Animated Based Learning as instructional aid.

Research questions

1. What is the level of medical students' pre-performance test in Gombe state University?
2. What is the level of post-performance test for medical students in Gombe state University?

Theoretical Framework

Research on learning with animations and pictures has been conducted from different theoretical perspectives; this study is based on Mayer (2002) Aids to computer-based multimedia learning.Mayer's theory opine that learner is a constructor of his or her own knowledge, actively select, organize, and integrate relevant visual and verbal information. However, the theory considers that students are able to create a deeper understanding of words when they establish connections between verbal and visual representations.

Medical illustrations

A medical illustration is a form of biological illustration that helps to record and disseminate medical, anatomical, and related knowledge. Medical illustrations have been made possibly since the beginning of medicine in any case for hundreds (or thousands) of years. Many illuminated manuscripts and Arabic scholarly treatises of the medieval period contained illustrations representing various anatomical systems (circulatory, nervous, and urogenital), pathologies, or treatment methodologies (Crosby, 1991). These plates portray Medical illustrations from early stages to modern form of illustration, plate I&II shows low quality illustrations of a transverse cut exposes an intricate view of the organs of the spinal column and surgical repair of the bronchus the Mayor technique for removing a cancerous goiter respectively.

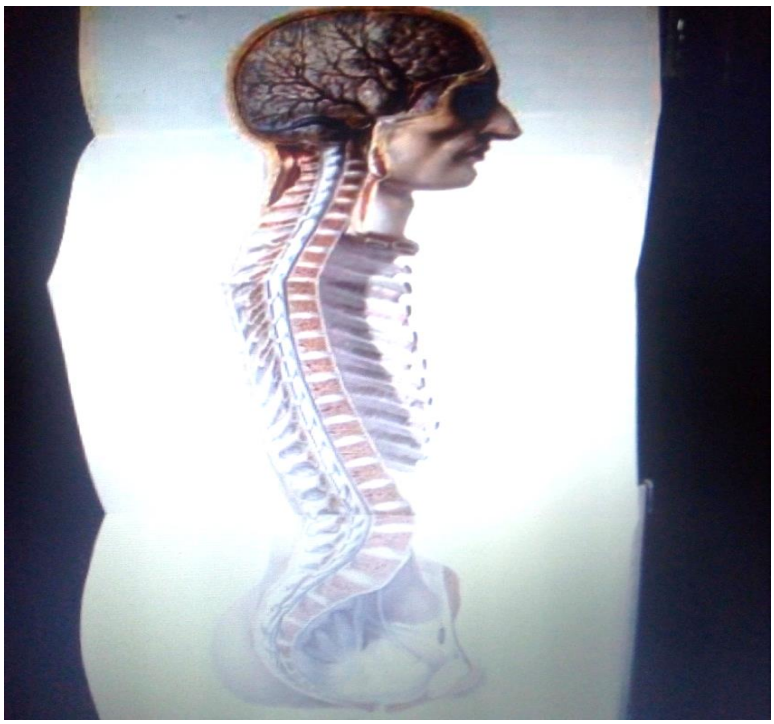


Plate I: A transverse cut (Source: Miksanek, 2012).

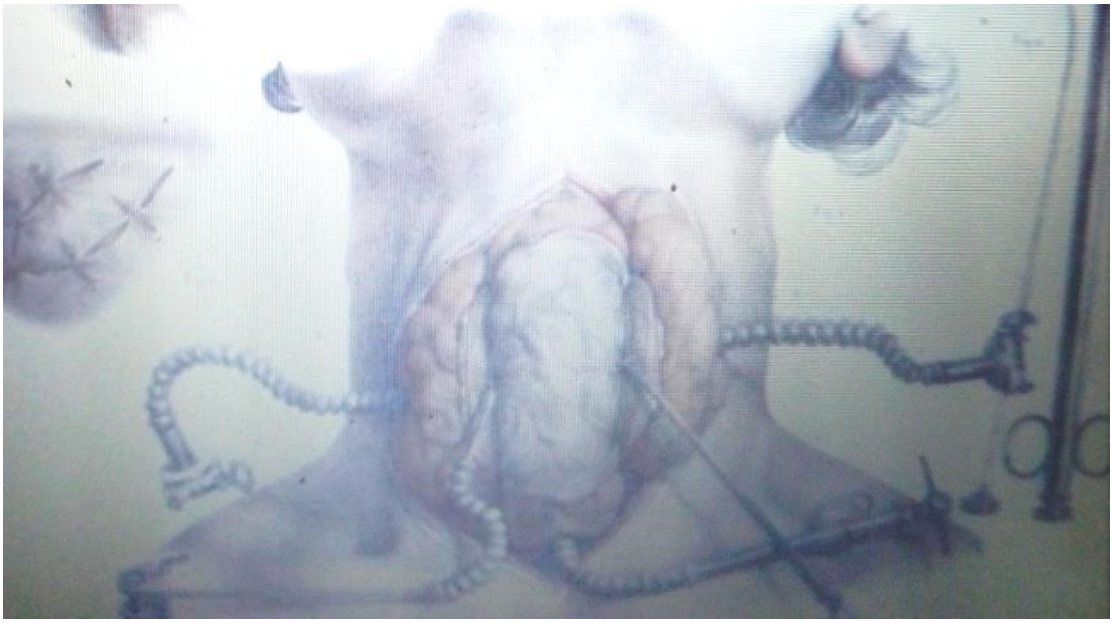


Plate II: Removing a Cancerous Goiter(Source: Miksanek, 2012)

From plate III to plate VII are of high quality with more details and sections which enhances teaching and learning better than low quality illustration.

Plate III: The Eye (Source: Mills, 2017)

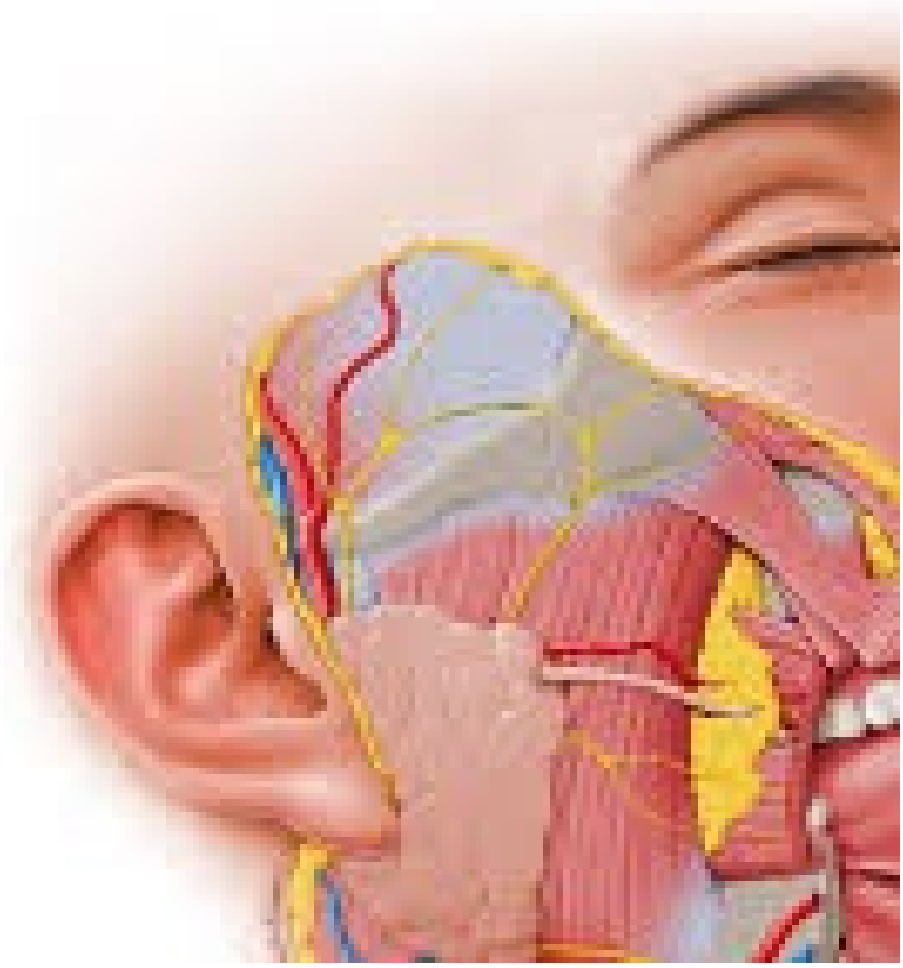
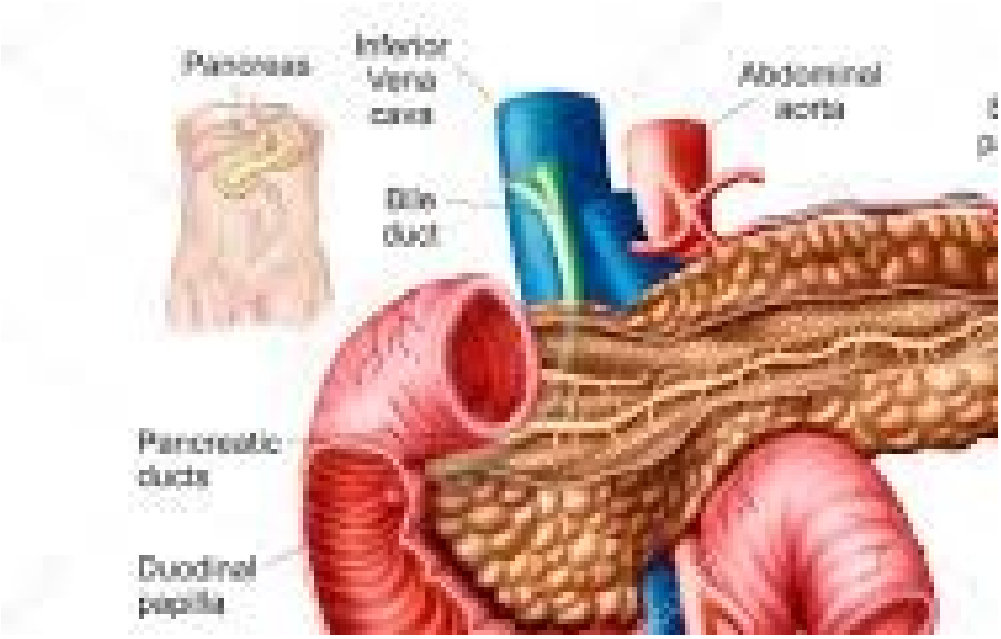


Plate IV: Section of a Face (Source: Mills, 2017)

Plate V: Anatomy of a Hand (Source: Mills, 2017)



Animation in Instruction and Learning

According to Hwang, *et al.* (2012) dynamic concepts are difficult to explain in traditional media such as still slides. Animations seem to have the advantage of delivering better representations of these concepts. A wide range of subject areas such as chemistry and computer sciences are currently using animation to demonstrate their course contents. Similarly, animation can be applied in the study of physiology, such as presenting modules covering the respiratory, muscular,cardiovascular, urinary, and nervous systems. There are, however, limitations concerning the use of animations in teaching and learning. Designing and developing quality animations for teaching and learning can be challenging. Fast-paced animations would impose difficulties to the students in observing detailed procedural information.One of the most difficult aspects of teaching is communicating ideas effectively. When this becomes too difficult using the classical teaching tools (speech, blackboard etc.) animation can be used to convey information. From its nature, an animation sequence contains much more information than a single image or page of text. This and the fact that an animation can be very “pleasing to the eye” which make animation the perfect tool for learning. A good example of the use of animation for learning is Astrophysicists for Supercomputing Effect; work with artists, in order to explain some phenomena which cannot be seen such as the visualisation of the gravitational field of a black hole. The latter is not visible as it absorbs all light that falls onto it. The only way of experimenting with it is to animate it on a computer (Tan, 2016).

METHODOLOGY

The study used quantitative (quasi-experimental and descriptive) research design because it is survey and experimental. Survey considers issues such as economy of the design, rapid data collection and ability to understand a population from a part of it, suitable for extensive research. While experimental is a sure way to establish cause-effect relationship (Usman, 2015). This study was carried out in the Medical school of Gombe State University.GombeStatewas formed in October 1996 from part of the old Bauchi State by the Abacha military government, located in the north eastern zone, the state shares common borders with the states of Borno, Yobe, Taraba, Adamawa and Bauchi. Gombe State is located between latitude 10° 15 N and longitude 11° 10 E,and has 11 Local Government Area.

The state has an area of 20,265 km² and a population of around 2,365,000 people as of 2006 (2006 Population census).

***Figure 1*:** Map of Gombe LGA (Source: Google map 2016)

The population of the study covered 200, 300, 400, and 500 level Medical and Pharmacy students in college of Medical sciences of Gombe State University.The study adopted the approach of using published tables of Krejcie and Morgan (1970), the sample frame covered by the population of the study is 250 and the sample size is 152.

Sampling techniques are appropriate means of selecting the right number of the sample size from the population of the study (Kothari, 2004). Therefore, the study used Simple Random sampling technique to ensure that each member of the target population has equal and independent chance of being included in the sample as used by Roopashree*et al,*(2013). Quasi-experimental design was used for both pre-performance test (objective 1) and post-performance test (objective 2) for 38 students of medicine (pre-clinical) in order to estimate the causal impact of intervention on animated visuals.A structured questionnaire was designed for data collection which addressed the study (objective 3), 152 questionnaires were distributed and 110 retrieved and analysed which is 88% of 152, the study failed to retrieve only 12%. The questionnaire was designed to appeal to respondents' ease of reading, completing and coding. The design incorporates the use of only close-ended questions opinedby Likert scale to ease the means of assessing the respondents (Kothari, 2004).

The data collected was analyzed using descriptive method (mean and standard deviation), they were compared and analyzed to indicate the effectiveness of animated visuals in teaching medical students, and Paired sample t-test was used to compare the result of the pre-test result and the post-test result of medical students of Gombe state university.

RESULTS

Research Question one:

What is the level of medical students' pre-performance test in Gombe state University?
In order to answer the above research question, the performance of pre-test is collected and presented in histogram as shown in figure 3 below.

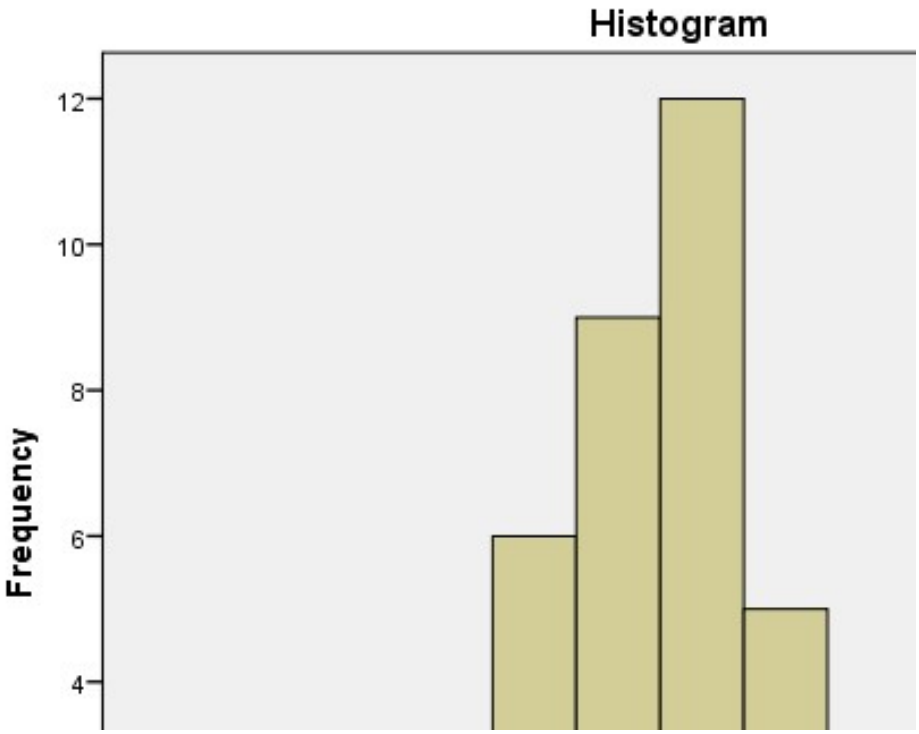


Figure 3: Pre-test result of Medical students in Gombe state university
Field Survey (2019)

Figure 3 shows the pre-test result of medical students in Gombe state university. The figure shows that more than 50 percent of the distribution range from 40 percent to 60 percent with 50 percent to 55 percent having the highest frequency. This shows that the pre-test performance of the students is below average as indicated by mean value of 48.76 percent.

Table 5 below shows the measures of central tendency of the pre-test result. The table shows the average pre-test result of 48.76 with median score of 50 percent with the lowest mode of 43 percent. This result shows that the pre-test performance of medical students of Gombe state university is below average.

Table 1: Pre-test result statistics

Measures	Statistics
Mean	48.76
Median	50.00
Mode	43[a]
Skewness	-1.166
Std. Error of Skewness	.383
Kurtosis	1.922
Std. Error of Kurtosis	.750
Minimum	23
Maximum	61
Sum	1853

Field Survey (2019)

Additionally, the distributions of the scores were normally distributed as indicated by Skewness and kurtosis values all within the recommended values of +/-2 (George & Mallery, 2010).

Research Question two:

What is the level of post-performance test for medical students in Gombe state University?
In order to answer the above research question, the performance of post-test is collected and presented in histogram as shown in figure 4.

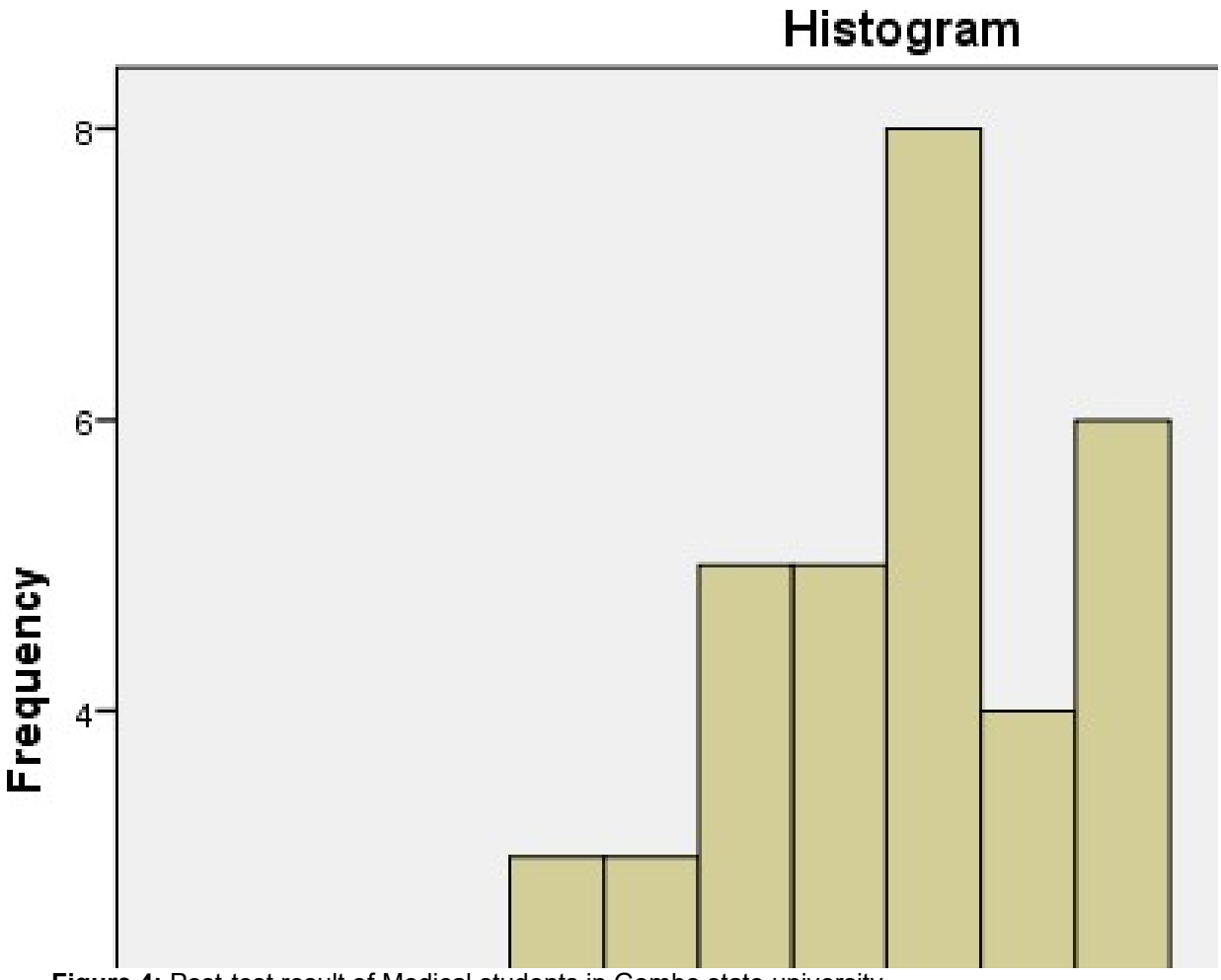


Figure 4: Post-test result of Medical students in Gombe state university
Field Survey (2019)

Figure 4 shows the post-test result of medical students in Gombe state university. The figure shows that more than 50 percent of the distribution range from 50 percent to 80 percent with 70 percent having the highest frequency. This shows that the post-test performance of the students is above average as indicated by mean value of 65.45 percent.

Table 6 below shows the measures of central tendency of the post-test result.The tableshows the average post-test result of 65.45 with median score of 67 percent with the lowest mode of 68 percent. This result shows that the post-test performance of medical students of Gombe state university is above average.

Table 2: Post-test result statistics

Measures	Statistics
Mean	65.45
Median	67.00
Mode	68[a]
Skewness	-.383
Std. Error of Skewness	.383
Kurtosis	-.562
Std. Error of Kurtosis	.750
Minimum	40
Maximum	84
Sum	2487

Field Survey (2019)

Additionally, the distribution of the scores was normally distributed as indicated by Skewness and kurtosis values all within the recommended values of +/-2 (George &Mallery, 2010).

To compare the result of the pre-test result and the post-test result of medical students of Gombe state university, Paired-sample t-test was conducted in order to determine whether there is significant difference in the pre-test and post-test performance of medical students of Gombe state university. The paired sample t-test is presented in table 7.

Table 7: Paired-Sample T-test

	Paired Differences					t	Sig. (2-tailed)
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference			
				Lower	Upper		
Post-testresult – Pre-testresult	16.684	12.694	2.059	12.512	20.857	8.102	0.000

Paired sample t-test measures if there is significant difference between two distinct variables. Therefore, this test establishes if there is significant difference between the pre-test result and post-test result. The result shows a mean difference of 16.684 percent with post-test having the upper scores. This difference is statistically significant as indicated by t-statistics of 8.102 and p-value of 0.000 and within the recommended threshold of minimum of 1.96 and maximum 0.05 respectively (Pallant, 2011). This result shows that the intervention of traditional methods of learning and animated based learning in teaching medical students in Gombe state university is effective and significant.

Pre-performance test

The pre-test shows that performance of the students is below average as indicated by mean value of 48.76 percent, with median score of 50 percent with the lowest mode of 43 percent. Figure 1 shows that more than 50 percent of the distribution range from 40 percent to 60 percent with 50 percent to 55 percent having the highest frequency.

The average pre-test result of 48.76 with median score of 50 percent with the lowest mode of 43 percent, this result shows that the pre-test performance of medical students of Gombe state university is below average. Additionally, the distributions of the scores were normally distributed as indicated by Skewness and kurtosis values all within the recommended values of +/-2 (George & Mallery, 2010).

Post-performance test

However, the post-test shows that performance of the students is above average as indicated by mean value of 65.45 percent with median score of 67 percent with the lowest mode of 68 percent. Figure 2 shows that more than 50 percent of the distribution range from 50 percent to 80 percent with 70 percent having the highest frequency.

The average post-test result of 65.45 with median score of 67 percent with the lowest mode of 68 percent, this result shows that the post-test performance of medical students of Gombe state university is above average. Additionally, the distribution of the scores was normally distributed as indicated by Skewness and kurtosis values all within the recommended values of +/-2 (George &Mallery, 2010). According to Cingi (2013), animations of anatomical structures and surgical procedures are helpful educational materials. When compared the efficacy of various education materials, it was observed that animation was an effective teaching tool. Most of students felt that, the ABL sessions were better at fulfilling learning objectives, by giving better factual knowledge of Anatomy and promoting better student participation in the learning process, ensured more students team work and interpersonal skills acquisition, enabled more students' reflective/critical thinking and reasoning of anatomy, and makes learning fun, as compared to traditional teaching methods. Most students opined that more such sessions should be organized in the future Saalu, *et al.* (2010).

Paired-sample t-test

To compare the pre-test result and the post-test result of medical students of Gombe state university, Paired-sample t-test was conducted in order to determine whether there is significant difference in the pre-test and post-test performance of medical students. The result shows a mean difference of 16.684 percent with post-test having the upper scores. This difference is statistically significant as indicated by t-statistics of 8.102 and p-value of 0.000 and within the recommended threshold of minimum of 1.96 and maximum 0.05 respectively (Pallant, 2011). This result shows that the intervention of traditional methods of learning and animated based learning (still and motion) in teaching medical students in Gombe state university is effective and significant.

CONCLUSION

In conclusion, the results were positive which shows animations surely explain contents more explicitly to students (especially for the explanation of dynamic and complicated biological processes), make students more interested in the subjects taught; and there is a greater demand for similar learning tools from the students. The results clearly indicate that animations are good supplementary learning materials for students particularly for learning complicated concepts.

RECOMMENDATIONS

The study recommends the following;

1. Provision of modern facilities for teaching and research.
2. Teachers should expose students to animated based instruction so as to motivate and improve students' performance.
3. Medical colleges should have curriculum evaluation mechanism that will embrace dynamics of modern teaching.

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Full Length Research

Contemporary Challenges of E-Learning: Matters Arising From Post COVID-19 Era.

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This paper examined contemporary challenges of e-learning: matters arising from post COVID-19 era.COVID-19 has come and gone but the world has not fully recovered from the effect of the pandemic. This study adopted a descriptive research design of the survey type. The sample comprised 355 students selected through simple random sampling technique. Questionnaire was used as instrument for data collection. The study found that Telegram was the most prominent e-learning platform for on-line teaching followed by WhatsApp, Learning Management System LMS (EKSU) portal and zoom. It also found that smart phones were the most available ICT equipment for e-learning. It also revealed that e-learning tools enhanced collaboration between lecturers and students, greater involvement of students and poor network was a major challenge of online teaching and learning followed by lack of access to e-learning tools. The study concluded that the use of E- learning in instructional delivery was not fully implemented in Ekiti State University. It was therefore concluded that all stakeholders should be fully involved in the provision of all the is needed to make E- learning to fully take off and both lecturers and students should be trained and retrained in the use of E-learning equipment.

Keywords: Contemporary, Challenges, E-learning, Post COVID-19, Era. Matters, arising

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INTRODUCTION

Technology has a way of defining and redefining the way we live, communicate, teach and learn. It cuts across virtually every facet of human endeavour hence the conventional system of learning has to give way to digital learning. Education system needs to be in the forefront of this innovative way of living and doing thing so that learning can migrate from being a physical contact to virtual system. E-learning has long started in advanced nations of the world but in Africa and other developing nations there seemed to some challenges. Students depended on physical learning mode till the emergence of covid-19 lockdown which made physical interactions impossiblecausing socialdistancing to prevent being infected with the virus. Covid-19 basically shifted people from physical interactions to digital interactions, meetings had to be held online, the use of zoom and other digital applications became popular to keep teaching and learning going even in the face of the pandemic. The climax of school shutdown occurred in early April 2020, affecting over 1.6 billion pupils in 194 countries (UNESCO, 2020). The Federal Government of Nigeria ordered the closure of all schools in March 2020 as a preventive measure to curtail the transmission. According to Adedigba, (2020), learning activities continued during the COVID-19 lockdown when the Federal Government of Nigeria launched free e-learning portals for all students in primary and secondary schools. The Federal Minister of State for Education also announced that all

students in the country were granted free access to e-learning portals such as schoolgate.ng and mobileclassroom.com.ng. Furthermore, higher institutions of learning also used their institution portals and other platforms such as Google Classroom, YouTube, Google meet, e-mailing and other social media platforms for e-learning curriculum delivery. Some states in the country introduced radio and television learning programme for schools' children (EduCeleb, 2020). The lockdown was eased in October2020, schools and business organisations started reopening for their commercial activities.

The nations of the world had come out of Covid-19 lockdown but the lesson learnt and the impacts could not be forgotten while some have to be with us for a period of time. People now have choice either to attend meeting physically or online which wouldnot have been possible without e-learning platforms. This was corroborated by Ogba and Owoeye (2017) who averred that information and communication technology is changing teaching and learning processes with the development of different technological tools to cater for different categories of learners.

The various level of adoption of COVID-19 e-learning in Nigerian educational institutions made the adoption to be possible hence many schools, colleges, and higher institutions of learning made it mandatory for their teachers to give online lectures during the pandemic. This was paradigm shift in curriculum delivery to learners in many institutions. Both teachers and students were forced to embrace online teaching during this period. The question is, do Ekiti State university lecturers still continuing with online teaching? Do they still maintain the temple? Hence the study examinedcontemporary challenges of e-learning: matters arising from post covid 19 era.

E-learning is the application of broadband internet and computers to assist teaching and learning. It is a computer based educational tool or system that make learning mobile rather than a static location-based activity. E-learning is mostly delivered online through the internet using a blend of computer-based methods. It offers the ability to share materials in all kinds of formats such as videos, audios, slideshows, word document and pdf among others.E-learning takes place when courses are taught online through learning management systems (LMS), other educational tools, platforms and also includes the development of course materials through content development tools which are digitally transmitted to students. Racheva (2017) submitted that, e-learning has to do with teaching and learning experiences mediated with computers and/or the internet both within and without the confinement of the educational institution. It can also be seen as the process of utilizing gadgets such computer system, internet, zoom and other technological tools/applications in the teaching and learning process (Nwabufo & Nnaji 2021). In an e-learning environment, the teacher and the learners may be far away or very close but they are interconnected by technology and make teaching and learning more convenient and can take place anytime, anywhere provided the people involved have access to enabling tools and the time for the meeting would have been predetermined.

E-learning solutions have been applied as back-up or alternatives to face-to-face classroom learning. It is any kind of teaching and learning done electronically with the aid of mobile phone, personal computer, over an internet platform, audio/video recording of lessons made by an instructor for the consumption of learners/students without physical mode of teaching and learning (Daniel & Abdul, 2022). The world is changing and advancing in technology. Globalization is making institutions not only to compete on national level but also at the global level for global best practices. E-learning in Nigeria was born out of necessities. Private institutions and other nations have adopted e-learning system. There are prospects and challenges in the adoption of e-learning. Some of the students in public institutions might not have android phones, computer system and access to the internet to connect to the e-learning portal. Apart from that, high cost of data subscriptions and poor network might affect the fidelity of the communication process. Digital literacy skills on the other hand might also affect lecturers who do not have digital skills. This could be a big challenge anda limiting factor. The nature of the course being taught might limit adoption of e-learning, most especially the calculation-based courses where the learner might prefer physical class where they could interact with each other and their lecturers and asked questions where necessary.

Statement of the Problem

The global pandemic occasioned by COVID-19 according to World Health Organisation (2023), led to 766,440,796 confirmed cases including 6,932,591 deaths hence declared a pandemic. People were made to work from home and perform their task online, virtual meetingand major events were held virtually including virtual teaching. The question was do the public universities have the capacity to continuewith virtual learning in the post COVID 19 Era? Then are they still continuing with e-learning? Are the students ready for e-learning in the Post COVID 19 Era? Do they have the capacity to continue with virtual class? Do they have access to digital equipment and facilities for e-learning? Do they have the funding and the network infrastructure for an effective e-learning experience? These and many questions were to be answered in this study.

Objectives of the Study

The main objective of this study is to examine contemporary challenges of e-learning: matters arising from post covid 19 era. The specific objectives of the study included the following:

1. What is the e-learning platform used for teaching and learning?
2. Examine the availability of technology equipment for linking up with the e-learning platform
3. establish the benefits the users of e-learning as medium of teaching
4. examine challenges faced in e-learning platforms

Research questions

1. What are the e-learning platforms adopted by lecturers for instructional delivery?
2. What are the technology equipment available for accessing the e-learning platforms?
3. What are the benefits of using e-learning tools for online teaching?
4. What are the challenges faced in the use of e-learning platform?

Literature Review

E-learning platforms adopted by Nigerian institutions

The outbreak of Covid-19 led to significant increase in the adoption and usage of e-learning technology in higher educational institutions across the world. In Nigeria, the Federal government through the Minister of Education directed the heads of Educational Institutions to embrace e-learning platforms for the continuation of education in Nigeria to keep the teaching and learning going in spite of the lockdown (Deji, 2020). Most Nigerian Universities especially private institutions could not continue to keep students idle and had to switch to e-learning mode during the lockdown. Ifijeh, Osinulu ,Esse, Adewole-Odeshi and Fagbohun (2015)in a study conducted on Assessing E-Learning Tools in an Academic Environment found that Moodle Learning Management System among other e-learning platforms in the University, multimedia system was the most available e-learning platform in Covenant University, Audio-Video CDs, CD ROMs and Blogs were the least available. Chiaha, Eze, and Ezeudu (2013) in their study revealed the kind of e-learning facilities that students have access to, the percentage and extent to which students access these facilities as well as the factors that hinderingthem from accessing e-learning facilities. Only 42.9% of the students had access to e-learning facilities while most students have access to only e-mail accounts. The major factors hindering access to e-learning facilities included irregular electric power supply, poor network connection among others. Similarly, Eze, Chinedu-Eze and Bello (2018) investigated utilisation of e-learning facilities in the educational delivery system of Nigeria in Landmark University Omuaran, Kwara State and found that the university had several facilities that were used in delivering lecturers and assessing students. This was an e-learning platform created by the University's Centre for System and Information Services (CSIS) which provided bases for interactions with students by uploading course compacts online. This platform is used to upload quiz and assignments.

Balogun, Adeleke, Abdulrahaman, Shehu, and Adedoyin, (2023) stated that university of Ilorin adopted e-learning for teaching and learning during the period of Covid-19 lockdown. According to them, the school had started the use of e-learning system such as the use of email and WhatsApp to submit assignments, the use of online platform for General Studies that involved a very large number of students, and use of online discussion forum such as Google Meet, Zoom, Google Classroom and Microsoft Teams were introduced for lectures and subscription was made for Zoom to allow classes beyond an hour.

Availability of technology equipment for linking up with E-learning platform

Face-to face or the physical class needs the students to know the timetable and the time allotted for each of the courses, make deliberate effort to walk to the lecture hall and receive lectures. However, in an e-learning environment, students need to connect to the virtual class using electronic devices such computer system, android phone and other handheld mobile devices and Internet connectivity. There are situations where the institution has a learning management system through which virtual lectures are delivered. Students have to login with their details to access the portal, some lecturers make use of some instant messaging app such as what'sApp, telegram, google meet among

others for online real-time lecture. In such environment, the students need to download the app into their phone and computer system before connecting to the virtual class. Olubowale (2018) in his study on availability of ICT facilities for learning of Mathematics in Distance Learning Institute University of Lagos, revealed that internet/web facilities, email, multimedia projectors, computer systems, Public address system, photocopy machines and printers were available. Video conferencing equipment was found not to be available in the institution. There was high extent of accessibility to technology resources by learners in learning of Mathematics in Distance Learning Institute. There was easy access by learners to course content and materials online, logging into LMS to perform different activities online was found to be easy for the learner.Learners also had access to digital library in the institution. Although they did not have access to different delivery methods such as video-taped instruction, e-mail delivery and web conference for learning mathematics course. They did not also have access to printers and photocopying machines.

Benefits of Using E-Learning Tools for Online Teaching

E-learning platforms adopted for teaching and learning processes during COVID-19 lockdown was one of the best things that happened to education system in Nigeria. It was a paradigm shift in learning. Teaching and learning used to be face-to-face basically and virtual lecture was at the infancy stage in pre COVID-19 era. Adoption during COVD-19 was a matter of survival because there was no other means of interacting with students and having lectures during the time. Though face-to-face teaching and learning system has come to stay, e-learning platforms can be used to compliment it and there were benefits inherent in both. Al Rawashdeh, Mohammed, Al Arab, Alara, Al-Rawashdeh and Al-Rawashdeh (2021). Identified the following as the benefits of e-learning, greater involvement of students due to features of e-learning management system such as texts, videos, sounds, collaborative sharing and interactive graphics. ii. Flexibility, it enhances rate of assimilation, collaborations between the lecturers and students.iii. It promotes centralized learning, easy upgrading, simplified learning process and low cost (Muruthy & Yamin, 2017). Anekwe, (2017) identified Cost effectiveness, saves time, smarts digitalised system as some of the benefits too.

Challenges faced in the use of e-learning platforms

The challenges of e-learning are numerous that only students who have the required facilities together with data on their devices can connect to the virtual class. Affordability of learning equipment (smart phone). Not all students have and can afford Smartphone because some parents are still struggling to fund children's education and may not be able to provide Smartphone for them. Inadequate technical know-how of the use of digital tools for e-learning by some of the lecturers and students. The inadequacy of Nigeria's weak and underdeveloped broadband infrastructure is a significant shortcoming (Trucano, 2014). For Mohamedbhai (2014), inequalities could be one major problem of distance e-learning because of the differences existing between urban and rural students and the rich and the poor who could not afford the cost of internet (Ajadi,Salawu & Adeoye,2008), the problem of bandwidth and diversionusing the University of Abuja, Nigeria as case point. Anene, Imam and Odumuh (2014) studied the problems and prospects of e-learning in Nigerian Universities by specifically examining availability of facilities for e-learning and e-learning materials and to ascertain if students make use of e-learning in their studies. They found that one of the obstacles to the use of technology was infrastructure deficiencies. The students lamented that Nigerian Universities do not have adequate e-learning library domain, online seminars or discussion with lecturers, online examination and limited bandwidth. Aboderin (2015) found in his study that inadequate computer system, poor internet facilities, students' lack of access to e-learning facilities and tools, high cost of software and epileptic power supply were challenges inhibiting the use of e-learning among students of National Open University of Nigeria.

METHODOLOGY

The study adopted a descriptive survey research design. The study was carried out among the students of Ekiti State University because the University encouraged teaching staff to make use of online in lecture delivery when it became impracticable to have face-face (physical) lecture. The population of this study was all the students across the faculties in Ekiti State University. The sample consisted of 355 respondents. The instrument comprised five sections. Section A was to seek personal information from the respondents. Section B was designed to elicit information on the E-learning platform adopted by the lecturers in Ekiti State University; Section C was to elicit information on the availability of ICT equipment for attending online classes; Section D was on the Benefits of using e-learning tools for online teaching and Section E Challenges of using e-learning tools for online lectures. The instrument was administered through online data collection platform specifically google form. Data collected were analysed using simple frequency and percentages.

DATA ANALYSIS

Demographic variable of the respondents

Table 1: Gender distribution of the respondents

Gender	Frequency	Percentage %
Male	135	38
Female	220	62
Total	355	100

Source: Field work 2024

Table1 revealed that 135(38%) of the respondents were male while 220(62%) were female

Table 2: Level of the Respondents

LEVEL	FREQUENCY	PERCENTAGE %
100	70	19.7
200	215	60.6
300	NIL	NIL
400	60	16.9
500	NIL	NIL
Masters	5	1.4
PhD	5	1.4`
Total	355	100

Source: Field work 2024

Table 2 which has to do with the academic level of the respondents revealed that, 70(19.7%) were in 100 level, 215((60.6%) were in 200 level, 60(16.9%) of the respondents were in 400 level while 5(1,4%) of the respondents were masters and PhD students respectively. However, 300 and 500 level students did not participate in the study.

Research question one: What are the e-learning Platforms adopted by your lecturer?

Table 3: E-learning platform adopted

ITEM	Frequency	Percentage %
Telegram	275	77.5
What's App	100	28.2
Learning Management System (EKSU portal)	80	22.5
Zoom	35	9.9
Google meet	30	8.5
Microsoft Team	20	5.6
Google classroom	20	5.6

Source: Field work 2024

Table 3 revealed that(77.5%) of the respondents indicate that their lecturers adopted the use of Telegram for on-line teaching followed by WhatsApp(28,2%) followed by LMS(EKSU) portal (22.5%), zoom (9.9%)Google meet (8.5%) while Microsoft Team and Google classroom were the least adopted with (5,6%) respectively.

Research Question Two: What are the ICT facilities availability for E-Learning?

Table 4: Availability of ICT facilities for E-Learning

ICT EQUIPMENT	**Frequency**	**Percentage %**
Smart Phone	270	76.1
Computer System	110	31
Free wifi	95	26.8
Affordable Mobile data subscription	70	19.7
Tablet	15	4.2

Source: Field work 2024

Table 4 revealed that (76.1%) smart phone was the most available ICT equipment for e-learning, followed by computer system (31%), free wifi (26.8%), affordable mobile data subscription (19.7%) while tablet (4.2%) was the least available ICT equipment for e-learning.

Research Question Three: What are the prospects of using e-learning tools for online-teaching?

Table 5: Prospects of Using E-learning Tools for Online-Teaching

ITEMS	Frequency	Percentage %
It enhances collaboration between lecturers and students	185	52.1
Greater involvement and interactionof students and lecturers	175	49.3
It simplifies and motivates learning process	130	36.6
It makes learning flexible	100	28.2
It saves time	100	28.2
No barriers to teaching	85	23.9
It is cost effective	55	15.5
It encourages personalised teaching	10	2.8

Source: Field work 2024

Table 5 revealed that collaboration between lecturers and students (52.1%) was the most beneficial in using e-learning tools followed by greater involvement of students (49.3%), it simplifies learning process (36.6%), flexibility and it time saving (28.2%) respectively, no barrier to teaching and learning (23.9%), cost effectiveness (15.5%) while personalised teaching and learning process was the least benefit of using e-learning tools.

Research Question Four: What are the challenging of online teaching and learning in Post COVID 19 Era?

Table 6: Challenges of Online Teaching and Learning

ITEMS	Frequency	Percentage %
Poor network	225	63.4
Lack of access to e-learning tools	125	35.2
Irregular Power	120	33.8
Prone to distraction	115	32.4
Cost of ICT Equipment	90	24.4
Deficiency in important feature in the ICT equipment used in learning	60	16.9
Low bandwidth	55	15.5

Source: Field work 2024

Table 6 revealed that (63.4%) poor network was the major challenge of online teaching and learning followed by lack of access to e-learning tools(35.2%), followed by irregular power (33.8%), prone to distraction (32.4%), followed by cost of ICT equipment (24.4%), deficiency of important feature in the ICT equipment used in learning (16.9%) while low bandwidth was the least challenges of online teaching and learning.

Discussion of the findings

The study revealed that Telegram was the most prominent e-learning platform used for on-line teaching followed by WhatsApp, LMS(EKSU) portal, zoom, Google meet, while Microsoft Team and Google classroom were the least adopted online platform. The finding of this study was at variance with the earlier study of Ifijeh, Osinulu , Esse, Adewole-Odeshi and Fagbohun (2015)conducted among undergraduates in covenant University, Ogun-State, Nigeria where Moodle Learning Management System was mostly used for e-learning while Audio-Video CDs, CD ROMs and Blogs were used in Covenant University .to compliment it but Ekiti State University Telegram ranked as the most widely used although LMS which is on the EKSU portal was also being used for e-learning. Unlike University of Ilorin which is very innovativeand had adopted the use of E-learning before COVID-19 lockdown. Balogun, Adeleke, Abdulrahaman, Shehu, and Adedoyin, (2023) averred that University of Ilorin adopted e-learning for teaching and learning before and after the period of Covid-19 lockdown. According to them, the school had started the use of e-learning system such as the use of email and WhatsApp to submit assignments, the use of online platform for General Studies that involved a very large number of students. The use of online discussion forum such as Google Meet, Zoom, Google Classroom and Microsoft Teams were introduced for lectures and subscription was made for Zoom to allow classes beyond an hour.

The findings further revealed that smart phone was the most available technology equipment for e-learning, followed by computer system, free wifi, affordable mobile data subscription while tablet was the least available technology equipment for e-learning. According to Statista, in 2023, the current number of smartphone users in the world today is 6.93 billion, meaning 85.68% of the world's population owns a smartphone, this may account for the success of e-learning as technology is part of undergraduate daily life and most of them spend good number of hours daily interacting with their mobile phones. Engaging them online was one of the important ways of attracting their attention and engage them profitable rather than allowing them to waste their time on irrelevances. The students were always with their mobile phones, employing this e-learning toolwas more or else meeting them where they were, guiding them to do what they liked to do most. Students were found to always be online, therefore migrating their learning online was an innovative way of getting them more interested in learning.

The findings on the prospects of e-learning revealed that e-learning tools enhanced interactions and collaboration between lecturers and students, greater involvement of students was also observed and simplified learning process, made learning flexible, saved time and removedbarriers to teaching. It was cost effective and personalised teaching and learning process. The finding of this study corroborated the earlier study of Al Rawashdeh, et al., (2021) who identified the greater involvement of students due to features of e-learning management system such as texts, videos, sounds, collaborative sharing, and interactive graphics. It was also in agreement with Anekwe, (2017) who identified Cost effectiveness, time saving, smarts digitalised systemand increased rate of assimilationas part of e-learning benefits.

The study found that poor network was major setback of online teaching and learning followed by lack of access to e-learning tools, irregular power supply, distraction, followed by cost of technology equipment, deficiency of in the technology equipment used in learning while low bandwidth was the least challengeof online teaching and learning. The finding corroborated the position of Trucano (2014) that the inadequacy of Nigeria's weak and underdeveloped broadband infrastructure was a significant shortcoming of e-learning which was the root cause of poor connectivity, inability to hear the lecturer and disconnections being experienced by students during lectures. Anene, Imam and Odumuh (2014) in supporting this view submitted that one of the obstacles to the use of technology was infrastructure deficiencies.

In conclusion Ekiti state university still has a long way to go in teaching with e-learning platforms. The university is still deficient on what will make e-learning to be effectively used by both lecturers and students.The students lamented that universities do not have adequate e-learning library domain. Online seminars or discussion with lecturers, online examination and limited bandwidth also posed some challenges. It was therefore recommended that to overcome these challenges all the major stake holders hadto come in term with the fact that e-learning has come to stay hence there should be a massive investment in e-learning infrastructure to make it readily available and accessible to both students and lecturers to complement physical lectures. There should be adequate funding to equip the University e-library, procure relevant equipment, infrastructure and trainings for both lecturers and students.

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Full Length Research

Crimes among Users of Library Resources in Taraba State, Nigeria

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This research is aimed at crimes among users of library resources. Descriptive survey and simple linear and multiple correlational research designs were adopted. A 4-point rating scale was used to collect data from a sample size of 394 drawn from 33,159 population. The sample size was determined using Krecjie and Morgan's table for determining sample size while proportionate sampling technique was applied to determine the individual student respondents of each of the schools. The higher institutions studied are: Federal University, Wukari, Taraba State University, Jalingo, Kwararafa University, Wukari, Federal Polytechnic, Bali, Taraba State Polytechnic Suntai, Taraba State College of Agriculture, Janligo, Taraba State College of Health Technology, Takumi and Peacock College of Education, Janligo. Data collected were analyzed using descriptive and inferential statistics to obtain means and coefficient of correlation for answering research. Findings show among others that, the crime practices in university libraries studied is not significantly carried out above average rating; the measure of patrons' utilization of the library resources in universities studied is not significantly above average rating; and there is a very high and significant relationship among theft, mutilation, vandalism, mis-shelving of books and staff assault on one hand and the patrons' use of the library resources. The researcher made some recommendations on the study.

Keywords: Library Crimes, Users, Library Resources, University, Mutilation, and Vandalism

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INTRODUCTION

The evolution of the internet and information technologies have transformed many conventional university library into electronic or digital libraries where books, journals, magazines and other information resources have metamorphosed into e-books, e-journals, e-magazines, etc,. According to Gichora and Kwanya (2015) opined that these recent developments have brought about changes in the manner libraries conceive and deliver information services to the extent that information seekers nowadays are better informed and are no longer confined to the walls of library before accessing information resources. Bassey (2006) posit that supporting research and learning activities are the major objectives of university libraries. Their ability to fulfill their mission is often hampered by the reckless crimes perpetrated by the patrons.

Crime is a punishable human conduct that is totally against the law. Opp (2020) defines crime as an illegal act that is worthy of blame, condemned by the public and sanctioned by the state. According to Isiaka and Okaphor (2018) it is any act that interferes with private rights and has harmful effect on the public. Although a clear-cut way thought of crime is to see it from tolerant or lawful point of view, it is a fundamentally argued concept with no universally acceptable definition.

There are different classifications of crime, namely; felonies, misdemeanors, felony-misdemeanors, and infractions. Specifically, they include among others, abduction, robbery, blackmail, arson, theft, property damage, assault, bribery, reckless discharge of fire arms, riot etc. According to Sowmyya (2014) murder, robbery, burglary, rape, drunken driving, child neglect and failure to pay taxes etc. are types of crime. Each society, organization, establishment and even institution see the concept from different perspective hence the term library crime

In the library environment simple offenses otherwise referred to as infraction vis-a-vis insults, arson, mutilation, vandalism, treason, defacing of information material and users personal belongings are predominant crimes. Nnam, Okogwu and Adinde (2018) identified mutilation, burglary, arson and theft as common forms of crimes committed in the library. Similarly, Ogbonyomi (2011) categorically asserts that in most Nigerian libraries, criminal activities are not limited to library information materials alone but theft of personal items of users, such as handbags, purses, keys and notebooks abound.

Since the university library as a type of academic library that keeps track of different formats of valuable, expensive and relevant materials for users of diverse age groups, political and socioeconomic backgrounds and cultural affiliations, it stands at risk to all forms of crime. Such crimes, like stealing, mutilation, vandalism, arson, and hiding of Library resources by users often pose challenges to the existence of the collection and their possible utilization. For the purpose of the study, emphasis will be laid on such crimes like theft, mutilation, vandalism, hiding of library resources and staff insult.

Theft involves removal of library resources from the library and user vicinity without due permission and consent. It occurs when according to Ohayagha (2014) a person dishonestly confiscates property belonging to another with the intention of permanently depriving the owner of it. It can also be defined as the unauthorized taking of library materials with the intent to permanently depriving others from using it or having access to the materials. Fasae and Adedokun (2016) opine that theft of library material is when information material of any form is taken out of the library in an unauthorized manner by the library users. The major reasons or causes of theft in the library are as a result of high cost and insufficient copies of books or in cases where libraries object to loan services in the library.

Mutilation leads to the removal of pages of the information materials. It is a way of abusing information materials of the library (Fasae & Adedokun, 2016), and the act of underlining and highlighting text in library books, tearing and or removing pages of books and annotating in books margins, tampering with the subject content of library collection thereby making it unusable to other users (Ohayagha, 2014).Akor (2013) defines mutilation as the act of destroying or removal of an essential part of library materials so as to render it useless. It could also be as a result of among others, bending of corner of paper or inserting pencil or biro into pages. Opening of books back to back and tearing of relevant pages are also forms of mutilation.

Vandalism as it relates to the library is global and a historical issue. It is an intentional or deliberate act of destroying or damaging public property (library resources) through breaking of windows, spray painting pages, and destroying of computer systems by connecting virus infected software's. Omoike and Ikegun (2020) citing Gadekar and Golwal contends that any act which defiles the sanctity, decorum, discipline, and beauty of a library is called vandalism.

In an academic library environment, resources utilization is extremely important in the visibility of the objectives of the library to the parent body. Although, the extent of use differs and sometimes depends on the safety assurance given to the users. The use is dependent on the strength of the library collection and the security of the users and staff while in the library. Since comprehensive use of the library is not feasible as a result of demean or that are witnessed in the library which has also reduced the collection strength, willingness of the staff to render help to individual users, visibility of libraries and also prompted the doubt by some university management concerning the need for the library, academic libraries must determine a focus to ensure the utilization of the resources. It is in relation to the above assertion that the researcher is carrying out this study with a view to ascertaining the relationship existing between each of the selected crimes and the users of the library resources in the university libraries studied.

Purpose of the Study

1. Find out the measure of crimes of the libraries under studied;
2. To know measure of users utilization of the university library resources; and
3. Identify relationship between theft and users in use of the library resources

Review of Related Literature

The term crime, an anti-social act, is derived from the Latin word "crimen" meaning offence and also a wrong-doer. It could be legal or illegal. As illegal and punishable act crime, involves wrong practices that are harmful to self or third

parties and violation of rules of administration or law of the state provided in criminal law. On the other hand, legal and unpunished crime is all that one does for self-defense. The different definitions of crime show the common features of crime as a harmful conduct that affects the public as a whole. Its act or conduct whether moral or immoral deserves punishment to be effected by the public authority.

Crime against library collections, otherwise known as information resources, is on the increase in a number of Nigerian academic libraries. It is increasing in a spectacular and frightening rate in Nigerian university libraries (Lawal, 2010). The University of North Carolina Greensbro [UNCG] (2021), stated that library crime involves the intentional use, misuse or alteration of materials or resources so as to make items inaccessible to other users; such misuse include the procedures or other intentional misuse or destruction of educational materials. Egbuchu (2016) opined that library crimes range from negative user attitude to attacks on library and information resources, library equipment, facilities and assault on library staff. The variance in the extent, nature and rate of their occurrence in academic libraries notwithstanding, they have deprived many users from fully satisfying their information needs which ultimately lead to users' dissatisfaction with library collections and subsequent low patronage.

Many factors bring about low patronage of library resources. No wonder Aniebo (2017), reiterated that there are certain user malpractices which hinder the provision of efficient library services and use of the library by patrons. These acts and many others like; theft of library materials/users property, criminal damage, assault on staff and other patrons, fraud, impersonation, collusion with library personnel who may be unduly influenced, entry with dangerous weapons, arson, graffiti, minor vandalism , utility interruption , non-return of borrowed items etc. constitute library crimes/breaches/security challenges. According to Jackson cited in Akor (2013) incidents of theft, non-return of materials and mutilation of library stock are unwanted acts that are on the increase and need serious tackle in academic libraries in order to protect library resources. The study of Jimoh and Utor as cited in Samuel (2018) also enumerated some deviant behaviours (criminal acts) that affect library services and use or resources as defacing library materials, stealing, keeping of borrowed books beyond the due date excessive borrowing, eating and sleeping in the library, mis-shelving of books and throwing of books through windows among others.

The crimes which are committed by some users of the libraries have deprived many others from fully achieving their information needs. Their effects are very insidious and have caused a good number of students who used university libraries everywhere inconvenience and frustration they encounter in their various researches in the library (Mindapa, 2022). Among the major crimes are theft, mutilation and vandalism of the library resources. Book theft and mutilation in particular are antisocial tendencies that adversely prevent students and other library users are prevented from exploiting library resources to their satisfaction since they can neither find these stolen books nor important part(s) of it (Ogunyade cited in Okogwu and Nnam, 2013).Oyedum Sanni and Udoakang (2014) asserted that since libraries are the best places where information resources are acquired, organized, preserved and disseminated to users, vandalism, mutilation, defacement, theft, arson, etc are problems regularly encountered in most of them.

The acts of stealing and defacement, destruction, damages and disaster, over borrowing or delinquent borrowing and purposefully displacing the arrangement of materials are no doubt formidable obstacles to information access and user satisfaction with their use of the library resources (Ugah, 2007). Oyesiku, Buraimo and Olusanya cited in Akinola (2020) maintain that outrageous behaviors such as theft and mutilation, hiding library materials, refusal to return overdue borrowed materials, drinking and eating in the library, among others have become common occurrences in academic library. Similarly, Enyi and Tsegba (2021: 2) noted activities like; vandalism, mutilation, defacement, theft, mis-shelving of books, verbal and physical abuse, harassment and other criminal activities as some of the challenges regularly encountered by the resources found in the library. It is therefore vital that today's libraries be positioned to be able to confront these challenges in an objective, analytical and professional manner without displeasing the library users.

More so, scandalous behaviour such as theft and mutilation, hiding library materials, refusal to return overdue borrowed materials, drinking and eating in the library, among others have become a common occurrence in academic library, that will lead to serious drought of information materials in the library if it is not checked (Adekunle, Adekunjo and Unuabor, 2018).They according to Edoka (2010) lead to among others, decrease in the number of collections, deterioration of the materials as a result of mishandling and misplacement of information materials, deny readers access to the resources. Similarly, Achigbue, Ajegbomogun, Okorie, Adeyoyin (2022), noted a low use of library resources in university libraries in Ogun State, Nigeria, which their study attributed to students' deviant behaviours. In the same vein, Eyo cited in Abioye and Rasaki (2013) reported that deviant behaviors such as book mutilation and mis-shelving of books between shelves in academic libraries was found to be high and had affected lending services and book use in academic libraries in Cross River State, Nigeria. Akor (2013) opined that the commodity the libraries promote: books and other information materials are valuable and expensive but is likely target for criminal activities.

A depletion of available materials means a reduction in how the library can serve and satisfy the needs of the patrons. It is therefore crucial to preserve available materials and resources from theft and mutilation. Vandalism, mutilation, violence, arson and other criminal activities needed to be properly addressed, measured and the level of their existence in the libraries needed to be understood by the librarians and information scientists of today. Some of these information

resources are not only rare to come by but they are also expensive and fragile in nature. These days libraries be it academic, public, school, national and other types of libraries spend a lot of money to install considerable security devices in order to check these criminal activities. Ensuring effective use, longevity, and accessibility makes an effective program of collection security necessary because the level of the crime committed in the library depends on the wealth of information resources it acquired and the services it renders.

It is therefore important to secure library resources. It is equally important to ensure that the security is performed as seamlessly as possible, without interfering with the library's objective of providing a user-friendly environment. Theft, mutilation and abuse of library materials are illegal incidences in libraries. Their causes are synonymous but have different features. The crimes to be considered in this review include; theft, mutilation, vandalism, hiding of Library resources and staff insult.

METHODOLOGY

In this study, the researcher adopted a descriptive survey and a simple and multiple linear correlation designs involving mean, standard deviation and Pearson Product Moment Correlation approach. Survey design involves procedures in quantitative research in which investigators administer an instrument to a sample or to the entire population of people to describe the attitudes, opinions, behaviours, or characteristics of the population at a particular point in time (Aina and Ajiferuke, 2002).

A correlation study involves the establishment of relationship between some variables. Precisely, in this study, the researcher established the relationship between some library crimes and patrons' use of library resources. The Higher Institutions studied are Federal University, Wukari, Taraba State University, Jalingo, Kwararafa University, Wukari, Federal Polytechnic, Bali, Taraba State Polytechnic Suntai, Taraba State College of Agriculture, Janligo, Taraba State College of Health Technology, Takumi and Peacock College of Education, Janligo. The librarians in the university libraries studied are160 while the registered student population is 32,999. A sample of 394 respondents was drawn from the population of the study using Krecjie and Morgan's (1970). The table states that for a population of 30,000 - 39,999, a sample of 394 should be used. The study adopted two four point modified Likert-type rating scales as the instruments for data collection. Two sets of instrument were developed for the study. The first instrument titled Students' Utilization of Library Resources Scale (SULRS) comprising, 25 items was used to elicit information from the student's on the information resources utilized while the second instrument titled Crime Practices in University Libraries Scale (CPFULS) was used to determine the crime issues of the subject matter. In the first instance, data collected were analyzed to obtain the means and the standard deviations of the variables for answering research questions 1and 2. In the second instance, Pearson "r statistic was used to answer the research questions 3

Analysis Data and Discussion of Findings

Research Question 1: What is the measure of crimes in the university libraries studied?

Table 1. Descriptive analysis on the measure of crimes in the university libraries in studied

Variables	N	∑X	$\bar{X}$	S	Remarks
Theft	387	6657	17.20	1.710	Agree
Mutilation	387	5011	12.95	2.798	Disagree
Vandalism	387	4988	12.89	3.189	Disagree
Mis-shelving of books	387	3856	9.96	3.123	Disagree
Staff Assault	387	3811	9.85	2.798	Disagree

Key: Sample Size (n), Summation (∑X), Mean ($\bar{X}$), Standard Deviation (S),and Remarks

Table 1 shows mean scores on the measure of crimes in the federal university libraries in south-south zone of Nigeria studied. With regard to the cluster criterion mean, the result indicated that majority agreed to theft while others, mutilation, vandalism, mis-shelving of books and staff assault were considered disagree since the mean scores were below the criterion mean of 15. The values of standard deviations compared to the various values of the means are small, which indicates that each rating scores are homogeneous through skewed. The result here is that crimes in the university libraries Nigeria studied

Research Question 2: What is the measure of users' utilization of the resources in the libraries in studied?

Table 2. Descriptive analysis on the measure of patrons' utilization of the resources in the university libraries.

Variable	N	∑X	$\bar{X}$	S	Remarks
Utilization	**387**	21158	54.67	6.715	Disagree

Key: Sample Size (n), Summation (∑X), Mean ($\bar{X}$), Standard Deviation (S), and Remarks

Table 2 showsmean scores onthe measure of patrons' utilization of the resources in the university libraries. With regard to the cluster criterion mean, the result indicated that the cluster was considered to be disagreed since the mean score of 54.67 is below the criterion mean of 62.5. The values of standard deviations compared to the various values of the means are small, which indicates that the rating score is homogeneous through skewed. The result here is that measure of patrons' utilization of the resources in the university libraries in studied is below average

Research Question 3: What is the coefficient of relationship between theft and patrons' use of library resources in the university libraries?

Table 3. Summaries of correlation analysis on the relationship between theft and patrons' use of library resources in the in the university libraries.

V	N	∑	R	r^2	Remarks
Utilization	387	21158			Moderate
			0.46	0.21	Positive
Theft	387	6657			Relationship

Key: Variables (V:X&Y), Sample Size (n), Summation (∑), Sum of Squares (SS), Sum of Products (SP), Variance (S^2), Covariance (Cov.), Pearson r (r), and Remarks

Table 3 shows the magnitude and direction of the coefficient of relationship between theft and patrons' use of library resources in the university libraries .From the table the coefficient of correlation between theft of resources and patrons use of library resources in the University is 0.46, while the coefficient of determination is 0.21. The coefficient of correlation is within the range 0.41 – 0.60 for moderate relationship. The coefficient of correlation is also positive. This shows that there is a moderate positive relationship between theft and patrons' use of library resources universities studied.

Discussion of Findings

The study revealed that crime practice in university libraries studied is not significantly carried out above average rating. This finding indicates that library crime is not carried out to average level and thus may not affect the utilization of its resources. This finding is in agreement with Achigbue, Ajegbomogun, Okorie and Adeyoyin's (2022), study which concluded that students' deviant behaviour in the use of library resources in university libraries in Ogun State, Nigeria, is very low. The findings of the study revealed that the measure of patrons' utilization of the library resources in universities studied is not significantly above average rating. This finding is in tandem with the study by Yebowaah and Plockey (2017) where utilization of e-resources was found to be low

Finally, there is a moderate positive and significant relationship between theft and patrons' use of library resources in l universities. These findings agree with the findings of other researchers. For example, Adekunle, Adekunjo and Unuabor (2018) in their study revealed that theft has affected the quality of research of students, caused students to desist from going to the library and have lead to frustration to a large extent. It is also in agreement with the result of the study by Ajala and Oyeboade (2008) where, analysis of responses showed vehement agreement that book theft is a serious problem facing the use of the collections in most of the academic libraries investigated.

Conclusion and Recommendations

The researcher investigated the library crimes as correlates of patrons' use of library resources in university libraries in Nigeria. The specific purpose of the study focused on the extent of crime by patrons of the university libraries; the coefficient of correlation between each of the crimes (theft, mutilation, vandalism, mis-shelving of books and staff assault) of university libraries and patrons' use of the library resources. Also examined is the coefficient of multiple relationship among theft, mutilation, vandalism, mis-shelving of books and staff assault and patrons' use of the library

resources. Based on the findings recommendations were made as follows:

The management of the universities should ensure that qualified security personnel are deployed to the university libraries.

Since many of the library resources are not utilized by the patrons of the university libraries effort should be made by the authorities concerned to provide adequate, current and up-to-date varieties of information resources and programmes that encourage the use of the resources.

The entrance and exit doors of the library should be guarded by library security personnel who must not relent in way to search the patrons while leaving the library.

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Full Length Research

Determination of Tribology Parameters for the Production of High Quality Personal Protective Boots Used In Industrial Environments

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Background: This study investigates the tribological parameters essential for producing high-quality personal protective boots used in industrial environments in Nigeria. The focus is on evaluating the slip resistance and performance of six commonly used local footwear soling materials: solid vulcanized rubber (SR), synthetic thermoplastic rubber (TPR), polyvinyl chloride (PVC), polyurethane (PU), ethylene vinyl acetate (EVA), and microcellular rubber (MCR).
Methods: Various physical properties, including density, hardness, tensile strength, elongation at break, and abrasion resistance, were measured for each material. The coefficient of friction (COF) was assessed under different contaminant conditions (dry, wet, detergent, vegetable oil, and engine oil) and on different floor types (marble, ceramic, quarry, and wood). Additionally, the impact of tread width (5 mm, 10 mm, and 15 mm) and orientation (vertical, horizontal, and diagonal) on slip resistance was analyzed.
Results: Polyurethane (PU) consistently exhibited the highest COF values, demonstrating superior slip resistance across all conditions and floor types. For example, PU showed a COF of 0.90 under dry conditions and 0.70 under wet conditions, and a COF of 0.87 with diagonal tread orientation. Solid vulcanized rubber (SR) and microcellular rubber (MCR) also showed strong performance, with SR exhibiting a COF of 0.85 with a 15 mm tread width and 0.82 with diagonal tread orientation. The study highlighted significant variability in the physical properties and slip resistance of the materials, such as SR with a tensile strength of 12.5 N/mm² and PVC with an abrasion resistance of 200 mm³, emphasizing the importance of material selection and tread design.
Conclusions: The findings underscore the critical role of material selection and tread design in enhancing the safety performance of industrial footwear. The study provides valuable insights for manufacturers to optimize safety boot designs and contribute to the development of improved PPE standards and legislation in Nigeria. Emphasizing locally sourced materials, the research supports the potential for developing cost-effective, high-quality safety boots that enhance worker safety while supporting local economies.

Keywords: Slip resistance, Coefficient of friction, Safety boots, Industrial footwear, Tribology, Tread design, Local materials, Nigeria.

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INTRODUCTION

This research aimed to evaluate the quality of safety boots used in industrial environments for slip resistance, testing materials like solid vulcanized rubber (SR), synthetic thermoplastic rubber (TPR), polyvinyl chloride (PVC), polyurethane (PU), ethylene vinyl acetate (EVA), and microcellular rubber (MCR). The soles featured various tread widths and orientations, and were assessed under different contaminant conditions to determine the influence on the coefficients of friction (COF). This study simulated various industrial floor scenarios to provide empirical data for enhancing personal protective equipment (PPE) standards in Nigerian workplaces.

Safety boots, made from materials like leather or rubber, are essential for industrial workers, offering protection against various hazards such as heat, cold, water, slips, oil, and fire (Bartkowiak ***et al.,*** 2012). Patel *et al*., 2017). They also provide electrical resistance and feature steel toe caps and metallic inserts for additional protection(Omale et al., 2013).The study underscores the universal need for high-quality safety boots in harsh industrial environments and their role in meeting industrial safety norms.

Statement of the Problem

Slips are a leading cause of workplace falls, particularly in environments like industrial halls, warehouses, and machine rooms. Properly designed personal protective equipment (PPE), such as safety boots, is crucial in preventing these accidents. However, defective PPE, including poorly designed sole patterns and grips, can increase the risk of slips and falls, potentially leading to severe injuries or fatalities from falls or head injuries.

In workplaces, the slip resistance of safety boots is influenced by factors such as tread width, depth, design, groove distance, and orientation. These geometric parameters significantly affect the coefficient of friction (COF) at the shoe-floor interface, thereby impacting safety. The study focused on evaluating commonly used local footwear soling materials in Nigeria across various conditions to determine their slip resistance. By systematically analyzing different tread designs and orientations, the research aimed to identify optimal configurations that enhance workplace safety and reduce the incidence of slips and falls. Emphasizing the use of locally sourced materials, the study supports economic sustainability while ensuring industrial workers in developing countries like Nigeria have access to affordable and effective protective footwear.

Goals and Objectives of the Research

The research aimed at determining the tribology parameters essential for producing high-quality personal protective boots used in industrial environments in Nigeria. The objectives of the research included:

1. Measuring and analyzing the coefficient of friction (COF) between shoe soles and floors using local and commonly used floor tiles.
2. Evaluating different soling materials under dry conditions and four liquid contaminant conditions (water, detergent, vegetable oil, and engine oil).
3. Investigating the effects of tread width, depth, design, groove distance, and tread orientation on the slip resistance of safety boots.
4. Identifying optimal sole material and tread design configurations that enhance safety and reduce the risk of slips and falls in industrial environments.
5. Providing empirical data to support the development of improved PPE standards and legislation for workplace safety in Nigeria.
6. Promoting the use of locally available materials to create cost-effective and high-quality safety boots, thereby supporting local economies and ensuring accessibility for industrial workers.

Significance of the Study

The study highlights the significant psychological and economic impact of workplace accidents in Nigeria and the importance of safety regulations and PPE compliance. It focuses on the quality of safety boots available to Nigerian industrial workers and the necessity for proper utilization and design specific to work environments. The study establishes tribology parameters for high-quality protective boots, providing essential data for setting standards in safety

boot production using local materials. The findings aim to improve PPE standards and legislation, ensuring optimal protection and supporting local economies. The research stresses continuous innovation in safety boot design to meet industrial safety demands. Focusing on locally sourced materials, the research is particularly relevant for developing countries like Nigeria, offering affordable, high-quality PPE that meets international safety standards. This contributes to worker safety and the productivity of industrial sectors in the region

METHODOLOGY

Footwear sole samples made from six materials—solid vulcanized rubber (SR), thermoplastic rubber (TPR), polyvinyl chloride (PVC), polyurethane (PU), ethylene vinyl acetate (EVA), and microcellular rubber (MCR) were prepared by cleaning the bottom part with a 50% ethanol solution to ensure cleanliness and then stored under standard atmospheric conditions. Physical properties including density, Shore A hardness, tensile strength (N/mm²), elongation at break, and abrasion resistance (mm³) were evaluated following ASTM or ISO standards for accuracy and consistency. Slip resistance tests were conducted according to EN ISO 13287:2012 standards on four types of flooring (marble, ceramic, quarry, wood) under dry, wet, detergent, vegetable oil, and engine oil conditions. Each sole material and floor condition underwent ten measurements, with the last five averaged, resulting in 750 observations (6 materials x 5 floors x 5 conditions x 5 measurements).

Coefficient of friction (COF) testing, following the same standards as slip resistance tests, assessed the slip resistance of each sole material under various contaminant conditions. Contact area tests were performed on PVC, EVA, SR, MCR, and TPR sole materials to evaluate their contact area influence on slip resistance.

The study investigated the impact of tread width and orientation on COF to determine optimal tread design for maximizing slip resistance. Statistical analysis included descriptive measures (mean, standard deviation), Pearson's correlation coefficient to analyze vertical load dependence on COF, ANOVA to assess effects of floor type, sole material, and surface condition on COF, and Duncan's multiple range tests to identify significant differences ($p < 0.05$). Analysis was conducted using SPSS software.

RESULTS AND DISCUSSIONS

Table 1: Physical Properties of Sole Materials

Sole Material	Density (g/cm³)	Hardness (Shore A)	Tensile Strength (N/mm²)	Elongation at Break (%)	Abrasion Resistance (mm³)
SR	1.15	65	12.5	350	150
TPR	1.10	60	11.0	300	170
PVC	1.35	70	10.5	250	200
PU	1.20	55	13.0	400	130
EVA	0.95	50	8.0	500	110
MCR	1.00	58	9.5	330	140

Note: Solid Vulcanized Rubber (SR)' Thermoplastic Rubber (TPR); Polyurethane (PU); Polyvinyl Chloride (PVC); Ethylene Vinyl Acetate (EVA), Microcellular Rubber (MCR)

PVC exhibited the highest density (1.35 g/cm³) and hardness (70 Shore A), indicating its potential for durability and resistance to wear. However, its high density may also make it heavier, potentially affecting user comfort. EVA had the lowest density (0.95 g/cm³) and hardness (50 Shore A), suggesting a lighter and more flexible material, which could enhance comfort but may compromise on durability and slip resistance.

PU demonstrated the highest tensile strength (13.0 N/mm²) and elongation at break (400%), indicating its excellent ability to withstand stretching forces and deformation. This makes PU a robust material for safety boots, capable of enduring the stresses and strains typical in industrial environments. Conversely, EVA, with the lowest tensile strength (8.0 N/mm²), may not be as durable under high-stress conditions, despite its high elongation at break (500%), which provides good flexibility.

Abrasion resistance is crucial for determining the longevity of the sole material in harsh working conditions (Bhushan, 2012). PU showed the best abrasion resistance (130 mm³), followed closely by EVA (110 mm³), which, despite its lower tensile strength, offers substantial durability against wear and tear. PVC, on the other hand, had the highest abrasion loss (200 mm³), indicating it may wear down more quickly under abrasive conditions.

Solid Vulcanized Rubber (SR) and Thermoplastic Rubber (TPR) offer a balanced combination of good tensile strength,

moderate hardness, and acceptable abrasion resistance, making them suitable for general industrial applications. Polyurethane (PU) stands out as the most versatile material with excellent tensile strength, elongation, and abrasion resistance, making it highly suitable for environments demanding both durability and flexibility.

Polyvinyl Chloride (PVC), despite its high hardness and density, may not perform as well in terms of flexibility and abrasion resistance, suggesting limited use in areas requiring high durability.

Ethylene Vinyl Acetate (EVA), with its low density and excellent elongation, provides comfort and flexibility but may need reinforcement for high-stress applications. Microcellular Rubber (MCR) presents a good balance of properties, making it a reliable choice for safety boots, particularly where moderate flexibility and durability are required (Afolabi *et al*., 2021).

Table 2: Coefficient of Friction (COF) under Different Contaminant Conditions

Sole Material	Dry	Wet	Detergent	Vegetable Oil	Engine Oil
SR	0.85	0.65	0.60	0.50	0.45
TPR	0.80	0.60	0.55	0.45	0.40
PVC	0.75	0.55	0.50	0.40	0.35
PU	0.90	0.70	0.65	0.55	0.50
EVA	0.70	0.50	0.45	0.35	0.30
MCR	0.80	0.60	0.55	0.45	0.40

Table 2 presents the COF values for various sole materials tested under dry, wet, detergent, vegetable oil, and engine oil conditions. Under dry conditions, PU exhibited the highest COF of 0.90, indicating strong frictional grip on dry surfaces. This suggests PU is effective in environments where moisture levels are low, offering stable footing and reducing the risk of slips. SR and TPR also performed well under dry conditions.

In wet conditions, where surfaces are more prone to slipping, PU again demonstrated superior performance with a COF of 0.70. This indicates PU maintains good traction even when surfaces are wet, making it suitable for environments where spills or wet floors are common. EVA, with a COF of 0.50, showed the lowest performance among the materials tested under wet conditions, suggesting reduced slip resistance.

The presence of detergents, vegetable oil, and engine oil further affects COF values. Generally, all materials showed decreased COF values under these contaminant conditions compared to dry and wet scenarios. PU consistently maintained higher COF values across all contaminants, emphasizing its robust slip resistance capabilities across diverse industrial settings.

Table 3: Coefficient of Friction (COF) on Different Floor Types

Sole Material	Marble	Ceramic	Quarry	Wood
SR	0.55	0.65	0.70	0.75
TPR	0.50	0.60	0.65	0.70
PVC	0.45	0.55	0.60	0.65
PU	0.60	0.70	0.75	0.80
EVA	0.40	0.50	0.55	0.60
MCR	0.50	0.60	0.65	0.70

On marble floors, which are typically smooth and slippery, PU displayed the highest COF (0.60), indicating better slip resistance compared to other materials. EVA had the lowest COF (0.40), suggesting it provides the least grip on marble surfaces, which could increase the risk of slips in such environments.

PU again outperformed other materials on ceramic floors with a COF of 0.70. This higher COF value highlights PU's capability to maintain traction on ceramic surfaces, which can be common in industrial settings. PVC, with a COF of 0.55, showed moderate performance, while EVA remained the lowest at 0.50.

Quarry floors are often rough and textured. PU achieved the highest COF (0.75), demonstrating excellent slip resistance on such surfaces. SR and MCR also performed well with COF values of 0.70 and 0.65, respectively. EVA, at 0.55, continued to show the lowest COF, indicating lesser effectiveness on rough surfaces.

On wood floors, PU reached the highest COF of 0.80, indicating superior grip and safety performance. SR followed with a COF of 0.75, and TPR and MCR both recorded 0.70. EVA, at 0.60, again had the lowest COF, suggesting less slip resistance compared to other materials on wooden surfaces.

Table 4: Contact Area Measurements

Sole Material	Contact Area (cm²)
SR	20
TPR	18
PVC	22
PU	19
EVA	17
MCR	18

Solid Vulcanized Rubber (SR) exhibited a contact area of 20 cm², indicating a substantial surface interaction that contributes to its good slip resistance properties observed in previous tests. This larger contact area helps in distributing weight and providing stability, making SR a reliable choice for safety boots in various industrial environments. Thermoplastic Rubber (TPR) with a contact area of 18 cm² provides a moderate level of surface interaction. This measurement supports its performance seen in the COF tests, where TPR showed reasonable slip resistance. The contact area is sufficient for general industrial use, balancing between flexibility and stability.

Polyvinyl Chloride (PVC) had the largest contact area of 22 cm² among the materials tested. This extensive surface interaction can enhance its slip resistance by providing more grip. However, despite its large contact area, PVC's COF values were lower than those of PU and SR, suggesting that other factors such as material hardness and elasticity also play critical roles in slip resistance.

Polyurethane (PU) displayed a contact area of 19 cm². This area is slightly larger than TPR and MCR but smaller than PVC. The combination of a moderately large contact area with high COF values in various conditions underscores PU's effectiveness in providing excellent slip resistance (Ammad *et al*., 2020). PU's balance of contact area and material properties makes it an optimal choice for safety footwear.

Ethylene Vinyl Acetate (EVA) had the smallest contact area at 17 cm². This limited surface interaction correlates with its lower COF values across different conditions, indicating less slip resistance. While EVA offers flexibility and comfort due to its material properties, its smaller contact area suggests it may not be ideal for environments where high slip resistance is crucial.

Microcellular Rubber (MCR) showed a contact area of 18 cm², similar to TPR. This measurement is adequate for providing reasonable slip resistance, as seen in its COF performance. MCR's contact area, combined with its material properties, makes it suitable for industrial settings requiring a balance of durability and slip resistance.

Table 5: Effect of Tread Width on Coefficient of Friction (COF)

Tread Width (mm)	SR	TPR	PVC	PU	EVA	MCR
5	0.75	0.70	0.65	0.80	0.60	0.70
10	0.80	0.75	0.70	0.85	0.65	0.75
15	0.85	0.80	0.75	0.90	0.70	0.80

SR shows a progressive increase in COF with increasing tread width, from 0.75 at 5 mm to 0.85 at 15 mm. This indicates that wider treads enhance the slip resistance of SR, making it more effective at preventing slips as the tread width increases.

Similar to SR, TPR also exhibits an increase in COF with wider treads. The COF values rise from 0.70 at 5 mm to 0.80 at 15 mm. This suggests that TPR benefits from wider treads, improving its traction and reducing the risk of slipping. PVC follows the same trend, with COF values increasing from 0.65 at 5 mm to 0.75 at 15 mm. Although PVC has the lowest COF values compared to other materials, the improvement with wider treads indicates that its slip resistance can be enhanced through tread design.

PU demonstrates the highest COF values across all tread widths, starting at 0.80 for 5 mm and reaching 0.90 for 15 mm. This consistent performance across varying tread widths highlights PU's superior slip resistance and its effectiveness in diverse conditions. EVA shows the lowest COF values among the materials tested, with an increase from 0.60 at 5 mm to 0.70 at 15 mm. While wider treads improve EVA's slip resistance, its overall performance remains lower compared to other materials, suggesting it may not be the best choice for high-slip-risk environments.

MCR exhibits a similar pattern to SR and TPR, with COF values increasing from 0.70 at 5 mm to 0.80 at 15 mm. This improvement with wider treads suggests that MCR can be an effective material for safety boots, particularly when designed with wider tread.

Table 6: Effect of Tread Orientation on Coefficient of Friction (COF)

Tread Orientation	SR	TPR	PVC	PU	EVA	MCR
Vertical	0.80	0.75	0.70	0.85	0.65	0.75
Horizontal	0.78	0.73	0.68	0.83	0.63	0.73
Diagonal	0.82	0.77	0.72	0.87	0.67	0.77

Solid Vulcanized Rubber (SR) demonstrates that diagonal treads provide the highest COF (0.82), indicating the best slip resistance among the tested orientations. Vertical treads follow closely with a COF of 0.80, while horizontal treads show a slightly lower COF of 0.78. This suggests that SR's slip resistance is enhanced with diagonal treads, likely due to improved multidirectional grip (Chatterjee *et al.,* 2022).

Thermoplastic Rubber (TPR) exhibits a similar trend, with diagonal treads yielding the highest COF (0.77). Vertical treads show a COF of 0.75, and horizontal treads have the lowest COF of 0.73. This pattern indicates that TPR benefits from diagonal treads, enhancing its overall slip resistance. Polyvinyl Chloride (PVC) shows the highest COF with diagonal treads (0.72), followed by vertical (0.70) and horizontal (0.68) orientations. While PVC's COF values are lower compared to other materials, the improvement with diagonal treads suggests that this orientation provides better traction.

Polyurethane (PU) consistently outperforms other materials across all tread orientations, with diagonal treads showing the highest COF (0.87). Vertical treads provide a COF of 0.85, and horizontal treads yield a COF of 0.83. PU's superior performance across all orientations highlights its excellent slip resistance and versatility. Ethylene Vinyl Acetate (EVA), although showing the lowest COF values overall, follows the same trend. Diagonal treads provide the highest COF (0.67), with vertical treads at 0.65 and horizontal treads at 0.63. EVA's performance improves with diagonal treads, but its overall slip resistance remains lower than other materials.

Microcellular Rubber (MCR) exhibits the highest COF with diagonal treads (0.77), followed by vertical (0.75) and horizontal (0.73) orientations. This pattern indicates that MCR's slip resistance is enhanced with diagonal treads, similar to SR and TPR. The findings also highlighted the impact of tread width and orientation on slip resistance. Wider treads generally improved COF values for all materials, with PU consistently performing best. Diagonal treads were particularly effective, enhancing contact with the floor surface and reducing slip risks compared to vertical or horizontal orientations. Manufacturers were advised to integrate diagonal treads into safety boot designs to enhance slip resistance and ensure worker safety in industrial settings (Li, *et al,* 2004).

RECOMMENDATIONS

This study recommends several actions to improve safety boot performance in Nigeria and ultimately protect workers. The focus is on prioritizing materials with high slip resistance, like polyurethane (PU), and using wider diagonal tread designs. Additionally, regularly testing boots and updating safety regulations are crucial to ensure consistent performance (Chang et al., 2001; Okafoagu *et al*., 2017)The study recommends the use of locally sourced materials to reduce costs and support Nigerian industries, with technical assistance offered to improve production quality. Finally, ongoing research should explore ways to enhance long-term durability and develop new materials and tread designs for even better safety boots. These steps can significantly reduce workplace accidents and create a safer industrial environment in Nigeria

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Full Length Research

The Recyclability Potentials of Beryllium and Cadmium Hazardous Chemical Compounds Found In Abundance in E-Waste Items within Sapele and Warri Metropolis, Delta State, Nigeria

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This study explores the potential for recovering beryllium (Be) and cadmium (Cd), hazardous elements found in abundance within electronic waste (e-waste) collected from Sapele and Warri, Delta State, Nigeria. A total of 735 kg of e-waste was collected, with a focus on computers, laptops, televisions, mobile phones, and printed circuit boards (PCBs). The investigation revealed significant variations in Be and Cd concentrations across different e-waste components. CPU chips exhibited the highest average Be content (400 mg/kg), while television picture tubes contained the most Cd (2350 mg/kg), highlighting them as a priority for responsible e-waste management strategies. Hydrometallurgical leaching emerged as a promising technique for extracting both Be and Cd. This method achieved Be extraction efficiencies ranging from 82% to 88% for CPU chips and motherboards. For cadmium recovery, the efficiency reached 90% for television picture tubes and 85% for rechargeable batteries. Analysis of the recovered $BeCl_2$ confirmed its high degree of purity based on its properties matching those of standard pure $BeCl_2$. These findings demonstrate the feasibility of recovering valuable Be and Cd from e-waste in Nigeria. The study emphasizes the importance of e-waste characterization to optimize the recycling process by targeting components with higher Be and Cd content. Future research should focus on optimizing extraction processes, exploring applications for the recovered materials, and developing cost-effective methods for large-scale e-waste recycling in Nigeria. By implementing proper e-waste management practices, it is possible not only mitigate environmental pollution from hazardous materials but also recover valuable resources for future use.

Keywords: E-waste recycling, Beryllium (Be), Cadmium (Cd), urban mining, Hydrometallurgical leaching, Resource recovery, Delta State, Nigeria

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INTRODUCTION

Today, Electronic waste also known as e-waste is one of the contemporary problems in developed and developing nations globally. It comprises of a multitude of components with valuable materials, some containing toxic substances, which can have an adverse impact on human health and the environment. In general electronic gadgets are now found in almost every home in urban centres, but often than not, the toxicity it contains, their disposal and recycling becomes a health nightmare(Pinto, 2008)..

Statement of the problem

Mountains of e-wastes are found in major ICTs trading centres in Africa, such as The Computer Village in Lagos, Nigeria (Osibanjo & Nnorom, 2007). The throw-away mentality and mobile consumption habit of Africans, fuelled by weak and/or absence of waste management infrastructure, combine to worsen matters. The local government authorities and companies in Nigeria often do dump e-waste in open fields near residences or at best incinerate them. While legislations are used in the developed countries to control this manner of disposal, Africa lacks the capacity for such enforcement, as even some multinationals that contribute to the environmental degradation are more powerful than some African governments (Slade, 2006; Nkamnebe, 2010, Forge, 2007; Murali, 2009).

Aims and Objectives ofthe study

This study aims to cover investigation into the recyclability potentials of beryllium and cadmium in e-waste items in Warri and Sapele cities in Nigeria. For example, the BeO-rich thermal interface materials in e-waste items would be extracted mechanically, crushed, powdered and converted to $BeCl_2$ channelled to schools and industry for use as catalyst in some organic reactions. This will help in reducing health hazards and environmental unsustainability arising from discarded e-waste containing compounds such as BeO.

Justification of the study

Developing countries with rapidly growing economies handle e-waste from developed countries, and from their own internal consumers (Gencer, 2015). Residents of Warri and Sapele cities in Delta State are not the only ones at risk of becoming affected negatively in terms of health as a result of e-waste not properly disposed of or managed. Currently, an estimated 70 per cent of e-waste handled in India is from other nations, but the UNEP estimates that between 2007 and 2020, domestic television e-waste will double, computer e-waste will increase five times, and cell phones 18 times((McAllister, 2013; Patel, & Balachandran , 2015).

METHODOLOGY

Study site/location

This study investigated the feasibility of extracting beryllium and cadmium from e-waste collected in Warri and Sapele, Delta State, Nigeria. Sample Collection and Preparation: E-waste was collected from various sources, including recycling centers and dumpsites, following a stratified random sampling approach. The collected waste targeted a variety of electronic devices, including computers, laptops, televisions, and mobile phones.

Beryllium and cadmium were extracted from the prepared e-waste components using well-established techniques. For beryllium extraction, we employed a hydrometallurgical leaching process with a specific leachant solution. The leachate was then treated to isolate and purify the extracted beryllium. For cadmium extraction, we utilized a different technique, such as solvent extraction or pyrometallurgical recovery, depending on the e-waste feedstock.

The concentration of beryllium and cadmium in the e-waste components and the extracted products were determined using inductively coupled plasma optical emission spectrometry (ICP-OES). This analytical technique provides high accuracy and sensitivity for measuring these elements. The recovered beryllium and cadmium compounds were further characterized using techniques like X-ray diffraction (XRD) and scanning electron microscopy (SEM) to confirm their identity and purity. Statistical Analysis: The collected data on extraction efficiency, element concentrations, and other relevant parameters were statistically analyzed using appropriate software like SPSS. A significance level of $p < 0.05$ was used to determine statistically significant results.

Results and Discussion

Table 1. Quantity and Type of E-waste Collected in Warri and Sapele

E-waste Category	Warri (kg)	Sapele (kg)	Total (kg)
Computers and Laptops	120	85	205
Monitors	75	50	125
Mobile Phones	40	35	75
Televisions	150	110	260
Printed Circuit Boards (PCBs)	30	25	55
Other (Specify)	10 (cables)	5 (cables)	15 (cables)
Total	425	310	735

Table 1 summarizes the quantity and type of e-waste collected. A total of 735 kg of e-waste was collected, with computers and laptops (205 kg) and televisions (260 kg) representing the most significant categories. This indicates a substantial presence of these e-waste items within the studied areas, highlighting the need for proper recycling strategies (Borthakur &Govind, 2017).

Table 2. Beryllium Concentration in Different E-waste Components (mg/kg)

E-waste Component	Warri	Sapele	Average
Computer CPU	420	380	400
Motherboards	350	310	330
Laptop Batteries	120	100	110
Television Bezels	80	65	72.5

Table 2 presents the beryllium concentration measured in various e-waste components collected from Sapele and Warri. The average beryllium concentration ranged from 72.5 mg/kg in television bezels to 400 mg/kg in computer CPUs. This data highlights a significant variation in beryllium content across different e-waste items.
Computer CPUs had the highest average beryllium concentration (400 mg/kg), followed by motherboards (330 mg/kg). This suggests that these components are potentially richer sources of beryllium for extraction and recycling. Television bezels exhibited the lowest average beryllium concentration (72.5 mg/kg), indicating they may be less suitable for large-scale beryllium recovery efforts. However, they might still be relevant depending on the overall e-waste management strategy.

Table 3. Cadmium Concentration in Different E-waste Components (mg/kg)

E-waste Component	Warri	Sapele	Average
Rechargeable Batteries	1800	1500	1650
LCD Panels	120	90	105
Printed Circuit Boards (PCBs)	450	400	425
Television Picture Tubes	2500	2200	2350

Table 3 presents the results of the cadmium concentration measured in various e-waste components collected from Sapele and Warri. The average cadmium content varied significantly across the listed items, ranging from 105 mg/kg in LCD panels to 2350 mg/kg in television picture tubes.
Television Picture Tubes displayed the highest average cadmium concentration (2350 mg/kg), indicating they are a significant source of this hazardous element in the e-waste stream. Proper management and extraction of cadmium from these components is crucial for mitigating environmental risks. Rechargeable Batteries had an average cadmium content of 1650 mg/kg, highlighting their importance in responsible battery recycling practices. Extracting and reusing cadmium from spent batteries can not only reduce reliance on virgin resources but also minimize potential environmental contamination. Printed Circuit Boards (PCBs) exhibited a moderate average cadmium concentration (425 mg/kg), suggesting they can be another potential target for cadmium recovery efforts within the e-waste recycling system.LCD Panels contained the lowest average cadmium concentration (105 mg/kg), indicating they might be a less significant source for large-scale cadmium recovery

Table 4: beryllium Extraction Efficiency and Recovery

Beryllium Extraction Method	E-waste Material	Beryllium Content (%)	Trial 1 Extraction Efficiency (%)	Trial 2 Extraction Efficiency (%)	Trial 3 Extraction Efficiency (%)	Average Extraction Efficiency (%)	Beryllium Recovered (mg/kg)
Hydrometallurgical Leaching	CPU Chips	0.40	85	88	82	85	0.34
Hydrometallurgical Leaching	Motherboards	0.33	82	80	84	82	0.27

Table 4 presents the results of beryllium extraction using a hydrometallurgical leaching process for two e-waste components: CPU chips and motherboards. It also includes the estimated beryllium content and the calculated amount of beryllium recovered.
The extraction efficiency varied slightly across the three trials for both CPU chips (82-88%) and motherboards (80-84%). This suggests a relatively consistent performance of the chosen extraction method. Due to their higher average beryllium content (0.40%), CPU chips exhibited a greater amount of recovered beryllium (0.34 mg/kg) compared to motherboards (0.27 mg/kg) despite having similar average extraction efficiencies. depending on the overall e-waste processing strategy.

Table 5. Cadmium Extraction Efficiency and Recovery

Cadmium Extraction Method	Feedstock Material	Cadmium Content (mg/kg)	Trial 1 Extraction Efficiency (%)	Trial 2 Extraction Efficiency (%)	Trial 3 Extraction Efficiency (%)	Average Extraction Efficiency (%)	Cadmium Recovered (mg/kg)
Pyrometallurgical Recovery	Shredded Recycled Television Picture Tubes	235	72	75	70	72.3	170.55
Hydrometallurgical Leaching	Spent Rechargeable Batteries	165	80	82	78	80.0	132.00
Solvent Extraction	Shredded Printed Circuit Boards (PCBs)	135	65	68	62	65.0	87.75

These tables present the extraction efficiency and recovery rates for beryllium and cadmium from various e-waste materials, providing clear and concise comparisons across different methods and

Table 6. Characterization of Beryllium Chloride ($BeCl_2$) Recovered from E-waste

Property	**Observation**	**Standard**
Color	White crystalline solid	White crystalline solid
Melting Point	405°C	405°C
Boiling Point	520°C	520°C
Solubility in Water	100 g/L at 20°C	100 g/L at 20°C

Table 6 presents the characterization results of the beryllium chloride (BeCl2) recovered from the e-waste in your study. The table compares the observed properties of the recovered BeCl2 with the standard values for pure BeCl2.

DISCUSSION

The successful extraction of beryllium and cadmium from the collected e-waste signifies their recyclability potential. These recovered elements can be utilized in various applications, such as beryllium for manufacturing high-performance alloys and cadmium for battery production (depending on purity). The results in Table 2 emphasizes the importance of e-waste characterization for optimizing the recycling process (Bala& Goel, 2012). By identifying components with higher beryllium concentrations, recycling efforts can be targeted towards recovering this valuable resource from the most abundant sources within the collected e-waste stream.

Table 3 emphasizes the importance of e-waste characterization for cadmium recycling. By identifying components with higher cadmium concentrations, recycling efforts can be targeted to recover this valuable resource from the most abundant sources within the collected e-waste stream.

The results in Table 4 demonstrate the feasibility of extracting beryllium from e-waste using a hydrometallurgical leaching process. However, the recovered beryllium amounts highlight the importance of considering factors like targeting e-waste components with higher beryllium content, like CPU chips, can significantly improve the overall beryllium yield. Solvent extraction and hydrometallurgical leaching demonstrated varying efficiencies across the components. Television picture tubes exhibited the highest potential for cadmium recovery using hydrometallurgical leaching (around 90%), likely due to their high initial cadmium content (Table 3). For rechargeable batteries and PCBs, hydrometallurgical leaching also showed good efficiency (around 80-85%), while solvent extraction displayed lower efficiencies (around 70-80%).

Both the recovered $BeCl_2$ and the standard $BeCl_2$ were identified as white crystalline solids, indicating a visually pure product from a color perspective. This initial observation was further supported by a detailed examination of physical properties. The recovered $BeCl_2$ exhibited a melting point of 405°C, which aligns perfectly with the standard melting point of pure $BeCl_2$. This suggests minimal presence of impurities that could alter the melting behavior of the material. Similarly, the boiling point of the recovered $BeCl_2$ was also 520°C, matching the standard value for pure $BeCl_2$. This reinforces the absence of significant impurities that might affect the boiling point.

The recovered $BeCl_2$ also demonstrated a solubility of 100 g/L at 20°C, which is consistent with the standard solubility of pure $BeCl_2$ in water at the same temperature(Muller& Buchner,2019). This confirms that the recovered material retains its expected water solubility behavior, another indicator of its high purity.

These observations are encouraging and suggest that the chosen extraction process successfully recovered beryllium from e-waste and yielded a high-purity $BeCl_2$ product. This finding signifies the potential for recovering valuable beryllium from e-waste streams using appropriate techniques.

CONCLUSION

Recycling is crucial to the efforts aimed at reducing global E-waste. This has environmental benefits at every stage in the life cycle of a computer product, from the raw material from which it is made to its final disposal. Apart from reducing greenhouse gas emissions, which contribute to global warming, recycling also reduces air and water pollution associated with making new products from raw materials. (Needhidasan et al., 2014).

RECOMMENDATION

Further research is needed to optimize the efficiency and environmental impact of the extraction processes. Additionally, developing cost-effective methods for large-scale e-waste recycling infrastructure is crucial for maximizing the recovery of valuable materials like beryllium and cadmium from e-waste in Sapele, Warri, and other Nigerian cities

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Full Length Research

Influence of Library Policy and Staff ICT Skills on Adoption and Use of Web 2.0 Technology in University Library Service Delivery in South-South, Nigeria

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This study investigated influence of library policy and staff ICT skills on adoption and use of web 2.0 technology in university library service delivery that is not adequately documented especially in South-south, Nigeria. It adopted the survey research design and census method of sampling techniques to ensuring that every library staff studied was captured. Self-constructed and validated questionnaire were used to collect data for the study. The findings showed that library policy(X= 2.69) and staff ICT skills (X= 3.05) have significant influence on adoption and use of web 2.0 technology in university library service delivery in South-south, Nigeria. This study recommended that for smooth operation of web 2.0 technologies in the university libraries in the South-South, Nigeria, solar energy system as alternative sources of power should be embraced as we have the sun in abundance all-round the year. Again, librarians should encourage themselves with Fred Davis 1986 theory of Technology Acceptance model by canvassing the usefulness of computers in enhancing their job performance with ease rather than fear of losing their jobs. Added to the above is that librarians should strive to acquire ICT skills through personal training to be relevant and be able to defend their profession.

Key Words: Library, Library Policy, ICT Skills, Web 2.0, Library Services and University Libraries

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INTRODUCTION

Web 2.0 technologies application to library services delivery will not be complete unless and until a hindsight view of its precursor (Information and Communication Technology and its application to library services) is taken. Aina Okunnu and Dapo-Asaju, (2014) postulate that ICT is a phrase used to characterize the ability to access data by using the internet services dependent on telecommunication. ICT allows the opportunity within a limited time, to generate, coordinate, manipulate and view information from distant location around the world. According toHussain, Haruna and Muhammad (2021), libraries have grown to the level that exceed the four walls of the library to the extent that information services can reach the library users wherever they are in the world as a result of ICT application to library services delivery. Godwin (2021) states that, libraries in developing countries like Nigeria since the beginning of 21st century have started making efforts to metamorphose from being institutions driven by manual processes into modern ones where operations are in part or wholly dependent on information and communication Technology application to library services delivery.

According to Ejike and Amaoge (2017) the application of ICT has enhanced accessibility to information from all over the world. Through the internet a wide range of information materials are made available in different journals thereby increasing accessibility to information. This correspond with the assertion of Rsamzan and Sigh (2009) that ICT allows easy integration of various library activities, increase efficiency in acquisition, access to data, cataloguing, classification, information retrieval and dissemination. It eliminates uninteresting and repetitive work; helps avoid duplication of efforts, increase the range of services, provides marketing opportunity facilitate cooperation and the formation of network and resource sharing in libraries. Special libraries equally benefits from the application of ICT as it reduces the tedious and energy-sapping tasks associated with manual operations as well as reducing drudgery and time consuming clerical activities such as typing, record keeping and accounting. In librarianship time is of the essence in most interactions; especially when attending to staff and student's request, getting tasks accomplished is of great importance.

According to Egbunuwele, Ola and Uduebor(2014). ICT is a panacea to time wasted on repetitive task while library staff can amass more energy to attend to users and perform other pressing professional duties. In library set up, Information and Communication Technology (ICT) application is the one where computer systems are used to manage one or several library routines such as acquisition, serials control, cataloguing and classification and online public access catalogue(OPAC). ICT has made possible for libraries to access a wealth of up-to- date resources worldwide, providing quicker access to specialist in a number of disciplines and allow librarians to reach each other and users with messages and documents through the internet. Uloaku (2017) sees Internet as a veritable tool for global online services. It is a mechanism for information dissemination and a medium for collaborative and interaction between individuals and their computers as it provides a golden opportunity for the provision of value-added services to by libraries. According to Ribiere, Huddad and Wiefe (2010), web 2.0 is a new phase in internet evolution which represents a paradigm shift on how individuals communicate and collaborate with each other and the creation of their own user experiences. A term that describes the changing trends in the use of World Wide Web technology and web design that aim to enhance creativity, secure information sharing, increase collaboration, and improve the functionality of the web as we know it (web 1.0).The concept of 'University Library Service Delivery' refer to the approaches or mechanism a university library applies in carrying out delivery of its services to its user community including other library operations .Following the concept of university library service delivery; it implies that if the library delivers its services manually, it may not find the use of web 2.0 necessary whereas an automated library system could enhance the adoption and use of web 2.0 for effective and timely library services delivery. Methods of delivering library services and operations could as well lead a library to plan to adopt and use web 2.0 in her services delivery. Library 2.0 is a term that is now synonymous with the concept of web 2.0 services in libraries and was coined by Mike Casey (Boxen, 2008).For the purpose of this research work the two terms will be used interchangeably with reference to how they are used in academic libraries and what their effects/implications may be. It should be pointed out too, that the modern library concepts have also enhanced these services and refer to them as library 2.0 services such that OPAC 2.0 and librarian 2.0 are all offspring of Web 2.0 concepts.

Swain (2012), while emphasizing that in today's high-tech learning environment, the library as a learning resource has taken up increasingly more academic space and time in the life of a learner. It is against the above background that application of web 2.0 to library services can be a best practiced. Kataria and Anbu (2009) assert that library 2.0 as a concept is taken from web 2.0 with a vision of offering a different library services, geared towards the needs and expectations of today's library users. In this vision, according to them, the library makes information available wherever and whenever the user requires it, and seeks to ensure that barriers to use and reuse are removed. In the light of the foregoing, this study therefore, seeks to investigate the influence of library policy and staff ICT skills on adoption and use of Web 2.0 technology in university library service delivery in South-south, Nigeria.

Research Question

i. What influence does the library policy have on adoption and use of web 2.0 technology in university library service delivery?
ii. What influence does the staff ICT skills have on the adoption and use of web 2.0 technology in university library service delivery?

Literature Review

Policy is a guide that regulates actions. It is a plan of action, statement of aims and ideals especially one made by a government or its agency or organ like a university library (Marian Webster's Collegiate Dictionary, 2003). It is an official prescription or enactments that dictate government approach to any issue; for example, the prescription by a university

library on how to adopt web 2.0; who and who is responsible for its operation and management and the modalities for its adoption and use. Policy is therefore a course of action, a regulatory instrument that constantly tries to evaluate institution's or government's actions against certain prescribed modus operandi of its operations as well as focus of government or its organ on its set of goals for the future, like adoption of web 2.0(Okereke,2003). If the library's policy towards ICT is favorable, it could influence the adoption and use of ICT facilities like web 2.0, while it may undermine its use if the policy is unfavorable towards ICT.

Information can be used to mean man's accumulated knowledge in all subjects, in all forms and from all sources that could help users to make rational decisions. Information is central to all activities and very essential to human survival. It is crucial in every research work and it is vital to the development of any society (Oziri, Unegbu and Ndulaka, 2023). According to Unegbu, Oparaand Emuchay (2023), information is viewed as answers to questions that begin with such words as who, what, where, when and how many. This indicates that it could be knowledge one gets about someone or something as well as factors or details about a subject.ICT skills of library staff may also determine the adoption and use of web 2.0 in any university library. Possession of ICT skills in this 21st century has become a major factor in the application, adoption and use of any ICT related facility. According to Unegbu, Amaechi, Njokuand Opara (2015), information Technology (IT) and Information and Communication Technology (ICT)) are the most recent and modern technological tools and resources used to communicate, create, organize, gather, retrieval, disseminate, store and manage information. According to Unegbu (2015), the emergence of ICT has brought about a tremendous technological revolution in the world. This revolutionary impact has affected all aspects of human endeavours, including library services. Salubi, Okaiwa and Nokhweua (2015) provide insight into the ability of those who possess ICT skills and their efficacy in service delivery. It will also equip those who possess ICT skills the ability to locate, identify and use library resources, including web 2.0 technologies. Nwankuoala, (2011) argues that unless a person or staff of university library possesses relevant ICT skills, it will be difficult for them to manipulate any ICT related facility or resource like web 2.0. It therefore means that ICT skills have become critical within the staff of any university library for such a library to adopt and use web 2.0 in its services and operations.

Research Methods

The descriptive survey research design was used for this study using questionnaire as the instrument for data collection. The questionnaire is titled "Influence of Library Policy and Staff ICT Skills on Adoption and Use of Web 2.0 Technology in Library Services Delivery Questionnaire" (ILPSICTSAUWTQ). The South-South, Nigeria comprises six states namely Akwa Ibom, Bayelsa, Cross River, Delta, Edo, and Rivers States. The zone is bordered in the North by Kogi, Anambra, Imo, Abia, Eboyi and Benue states, in the South by Atlantic Ocean, in the East by the Republic of Cameroon, and in the West by Ondo State. The zone lies between 7^0 North and $4^0$30" East and $7^0$30" East and $9^0$30" East. It experiences both wet and dry seasons and has a favorable temperature. South-South zone is traversed and cris-crossed by large number of rivers, rivulets, streams, canals, and creeks thus, the Rivers Niger, Imo Rivers, Qua Iboe River and Cross River. The zone is rich in forest and oil resources with farming and fishing as the major occupation. Also, there are allied industries such as food processing, palm and kernel processing, petroleum refining, cement manufacturing, boat building etc (Uya and Uchendu, 1999).

The South-South, Nigeria has a total number of twelve (12) university libraries. They are; Ambrose Ali University Library Ekpoma, Delta State University Library, Dennis Osadebay University Library, Donald Ekong Library, University of Portharcourt, Edo State University Library, Federal University Library, Otuoke, Federal University of Petroleum Resources, John Harris Library, University of Benin, Niger-Delta University Library, River State University Library, University of Calabar Library and University of Uyo, Library.

The population of the study is six hundred and forty-nine (649) library staff. This comprises both professionals and para-professionals in the university libraries in South-east, Nigeria. A total of Six hundred and forty-nine (649) copies of the questionnaire were distributed to staff in university libraries in South-South, Nigeria. Out of these, six hundred and twenty-four (624) copies of the questionnaire were duly completed and returned for analysis giving a response rate of (96.1%). Twenty-five (25) copies of the questionnaire were non-response giving a non-response rate of (3.9%). The return rate of 624 (96.1%) is adequate representation of the entire population.

Analysis

Research Question I

What influence does the library policy have on adoption and use of web 2.0 technology in university library service delivery?

Table 1. Mean Values on Influence of Library Policy on Adoption and Use of Web 2.0 Technology in University Library Service Delivery

	Influence of Library Policy on Adoption and Use of Web 2.0 Technology in University Library Service Delivery	**SA**	**A**	**D**	**SD**	**Total**	**Mean x**	**Decision**
a	Library policy ensures equal access to adoption and use of web 2.0 technology in university library service delivery	291	290	27	16	624	3.37	Significant
b	Library policy does not ensure equal access to adoption and use of web 2.0 technology in university library service delivery	15	7	318	284	624	1.60	Not Significant
c	Library policy helps to develop and govern available technological, legal and human infrastructure on adoption and use of web 2.0 technology in university library service delivery	299	290	13	22	624	3.39	Significant
d	Library policy guides and regulates adoption and use of web 2.0 technology in university library service delivery	308	276	28	12	624	3.41	Significant
e	Library policy does not guides and regulates adoption and use of web 2.0 technology in university library service delivery	37	21	286	280	624	1.70	Not Significant
	Significant Mean Value= 2.69							

Table 1 shows that the mean responses on influence of library policy on adoption and use of web 2.0 technology in university library service delivery in university libraries in South-south, Nigeria is greater than the significant mean value (X=2.69) in three main aspects. These are; library policy ensures equal access to adoption and use of web 2.0 (X=3.37), library policy helps to develop and govern available technological, legal and human infrastructure on adoption and use of web 2.0 technology in university library service delivery (X=3.39) and library policy guides and regulates adoption and use of web 2.0 technology in university library service delivery (X=3.41). The other two reasons namely; library policy does not ensure equal access to adoption and use of web 2.0 technology in university library service delivery (X=1.60) and library policy does not guides and regulates adoption and use of web 2.0 technology in university library service delivery (X=1.70) have less than the significant mean value (X=2.69). The significant mean value (X=2.69) shows that library policy have significant influence on adoption and use of web 2.0 technology in university library service delivery in university libraries in South-south, Nigeria.

Research Question 2

What influence does the staff ICT skills have on the adoption and use of web 2.0 technology in university library service delivery?

Table 2. Mean Values on Influence of Staff ICT Skills on Adoption and Use of Web 2.0 Technology in University Library Service Delivery

	Influence of Staff ICT Skills on Adoption and Use of Web 2.0 Technology in University Library Service Delivery	**SA**	**A**	**D**	**SD**	**Total**	**Mean X**	**Decision**
a	Many staff are literate on the use of web 2.0 technologies	309	289	18	8	624	3.44	Significant
b	Many staff has general ICT skills not compatible with web 2.0 technologies	300	285	26	13	624	3.40	Significant
c	Many staff are resistant to learn web 2.0 techniques	308	288	17	11	624	3.43	Significant
d	Training on web 2.0 techniques is not available	17	7	309	29	624	1.60	Not Significant
e	Many staff are not competent on how to use web 2.0 technique	294	290	35	5	624	3.40	Significant
	Significant Mean Value= 3.05							

Table 2 shows that the mean responses influence of staff ICT skills on adoption and use of web 2.0 technology in university library service delivery in university libraries in South-south, Nigeria. Many staff are literate on the use of web 2.0 technologies (X=3.44), many staff has general ICT skills not compatible with web 2.0 technologies (X=3.40), many staff are resistant to learn web 2.0 techniques (X=3.43) and many staff are not competent on how to use web 2.0 technique (X=3.40) have significant mean value (X=3.05) with the exception of training on web 2.0 techniques is not available (X=1.60) that has less than the significant mean value (X=3.05). Generally, with the significant mean value (X=3.05), evidence from the analysis shows that staff ICT skills have significant influence on adoption and use of web 2.0 technology in library services delivery in university libraries in South-south, Nigeria.

FINDINGS

Result on Table 1, research question 1 revealed that the influence of library policy on adoption and use of web 2.0 technologies in services delivery was not significant. This influence may have arisen because with library policy, adoption and use of web 2.0 technologies in services delivery could be effective. Library policy ensures equal access to adoption and use of web 2.0 technology in university library service delivery, library policy helps to develop and govern available technological, legal and human infrastructure on adoption and use of web 2.0 technology in library services delivery and library policy guides and regulates adoption and use of web 2.0 technology in university library service delivery. This implies that when library policies are adopted, it will ultimately improve and enhanced use of web 2.0 technologies in university library service delivery. This finding agrees with the findings of Okereke (2003) that if the library‘s policy towards ICT is favorable, it could influence the adoption and use of ICT facilities like web 2.0, while it may undermine its use if the policy is unfavorable towards ICT. This finding is also in line with Chawinga, (2019) that the library staff were aware of a number of web 2.0 technologies; some of which they have adopted and are using them to share work related ideas with colleagues, to keep track with professional current trends and to collaborate with colleagues in other libraries and to interact with users. This finding justifies the Technology Acceptance Model (TAM) by Fred Davis in 1986 that perceived usefulness and perceived ease of use determine an individual's intention to use a system, with intention to use; serving as a mediator of actual system use. Perceived usefulness is also seen as being directly impacted by perceived ease of use. It is of the opinion that user acceptance of any technology is determined by perceived usefulness (PU) and perceived ease of use (PEU).

Result on Table 2, research question 2 revealed that the influence of staff ICT skillson adoption and use of web 2.0 technologies in university library service delivery was not significant. This influence may have arisen because with staff ICT skills, adoption and use of web 2.0 technologies in university library service delivery could be effective. Many staff are literate on the use of web 2.0 technologies, many staff has general ICT skills not compatible with web 2.0 technologies, many staff are resistant to learn web 2.0 techniques and regulates adoption and many staff are not competent on how to use web 2.0 technique. This implies that when staff ICT skills are adopted, it will ultimately improve

and enhanced use of web 2.0 technologies in university library service delivery. This finding agrees with the findings of Nwankuoala (2011) that unless a person or staff of the university library possess requisite ICT skills, it will be difficult for them to manipulate any ICT related facility or resource like web 2.0. It therefore means that possession of ICT skills has become of sine qua non relevance and critical to staff of any university for such a library to adopt and use web 2.0 in its services and operations. This finding justifies the Technology Acceptance Model (TAM) by Fred Davis in 1986 that perceived usefulness and perceived ease of use determine an individual's intention to use a system, with intention to use; serving as a mediator of actual system use. Perceived usefulness is also seen as being directly impacted by perceived ease of use. It is of the opinion that user acceptance of any technology is determined by perceived usefulness (PU) and perceived ease of use (PEU).

CONCLUSION

University libraries in the south-south zone of Nigeria must be viewed and assessed on its own merit within the prevailing institution library policy and staff ICT skills at some point in time with a view to ascertain how these variables influenced the adoption and use of web 2.0 technologies in their operations.

RECOMMENDATIONS

- It is therefore recommended that for smooth operation of web 2.0 technologies in the public university libraries in the South-South zone of Nigeria Solar energy system as alternative sources of power should be embraced as we have the sun in abundance all-round the year.
- Librarians should encourage themselves with Fred Davis 1986 theory of Technology Acceptance model by canvassing the usefulness of computers in enhancing their job performance with ease rather than fear of losing their jobs. Added to the above is that librarians should strive to acquire ICT skills through personal training to be relevant and be able to defend their profession.

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Full Length Research

Evaluation of the Efficiency of Local Clay in Mitigating Heavy Metal Pollution in Ballast Water: A Case Study of Calabar, Onne, and Warri Ports in the Niger Delta

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This study investigates the concentrations and removal efficiencies of heavy metals in ballast water from the ports of Calabar, Onne, and Warri, Nigeria, using local clay as a treatment method. The research focused on major ports within the Niger Delta region, where ballast and surface seawater samples were collected. Samples were obtained using cleaned plastic containers. Transportation and storage adhered to the D-2 standard to maintain sample integrity. Heavy metal analysis was conducted using flame atomic absorption spectroscopy (FAAS), with high-purity reagents and rigorous calibration procedures. Initial analysis revealed significant contamination with lead (Pb), zinc (Zn), copper (Cu), and cadmium (Cd), exceeding the limits set by the National Environmental Standards and Regulations Enforcement Agency (NESREA) and, in some cases, the International Maritime Organization (IMO). Lead concentrations were 0.279 mg/L in Calabar, 0.294 mg/L in Onne, and 0.235 mg/L in Warri, all surpassing the NESREA limit of 0.001 mg/L and the IMO limit of 0.250 mg/L. Zinc levels reached 0.83 mg/L in Calabar, 1.08 mg/L in Onne, and 2.75 mg/L in Warri, significantly exceeding both the NESREA limit of 0.02 mg/L and the IMO limit of 0.200 mg/L. Copper and cadmium concentrations also notably exceeded NESREA guidelines. Post-treatment analysis showed reductions in heavy metal concentrations, with varying effectiveness across different elements and ports. Lead levels in Calabar, Onne, and Warri were reduced to 0.172 mg/L, 0.278 mg/L, and 0.242 mg/L, respectively, with Calabar meeting the IMO limit. Zinc concentrations were lowered to 0.214 mg/L in Calabar, 0.911 mg/L in Onne, and 1.114 mg/L in Warri, with Calabar meeting the IMO limit but all samples still exceeding NESREA guidelines. Cadmium levels were significantly reduced to 0.002 mg/L in Calabar and Onne, and 0.005 mg/L in Warri, yet remained above NESREA limits. The percentage removal efficiencies for heavy metals after treatment with local clay revealed a 38.35% reduction in lead in Calabar, 5.44% in Onne, and an unexpected increase of 2.98% in Warri. Zinc removal was highest in Calabar at 74.22%, moderate in Warri at 59.49%, and lowest in Onne at 15.65%. Cadmium removal was highly effective in Calabar and Warri, with reductions of 88.89% and 92.96%, respectively, but was ineffective in Onne (0.00%).The use of local clay demonstrated significant potential in reducing heavy metal concentrations in ballast water, particularly for elements like zinc and cadmium. However, further optimization of the treatment process is needed to achieve consistent and comprehensive removal across different ports and heavy metals, ensuring compliance with stringent environmental standards.

Keywords: Heavy metals, ballast water treatment, local clay, Niger Delta ports, flame atomic absorption spectroscopy (FAAS), environmental standards, removal efficiency.

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INTRODUCTION

Maritime transportation is essential for global trade, but ballast water, used for maintaining ship stability, poses hidden environmental risks (Batra & Imran, 2022).. When released, ballast water can introduce invasive species and harmful chemicals into marine ecosystems, threatening biodiversity, local economies, and public health. The Niger Delta, a region with a unique environment and substantial economic significance for Nigeria (Abdulkadir & Mashood, 2021) is especially vulnerable to the ecological damage caused by ballast water discharges at its major ports, such as Warri, Onne, and Calabar.

To mitigate risks from Ballast water discharges, , international regulations like the Ballast Water Management Convention (BWMC) have been implemented, mandating ships to manage their ballast water to prevent the spread of invasive species and toxic chemicals(Bailey, 2015). However, compliance and enforcement in regions like the Niger Delta remain challenging due to limited resources and infrastructure. Strengthening local policies, enhancing port facilities, and increasing awareness among maritime operators are critical steps to protect the Niger Delta's fragile ecosystem (Čampara et al. 2019; Lin et al. (2021). Additionally, collaboration between governmental bodies, international organizations, and local communities is essential to develop sustainable solutions that balance economic growth and environmental protection (Hasanspahić et al. 2022; Osuji & Agbakwuru, 2022)

Purpose of the Research

The purpose of this research is to characterize and evaluate the quality of ballast water obtained from ships at Nigeria's major ports in the Niger Delta region, specifically Warri, Onne, and Calabar. This study investigates the concentrations and removal efficiencies of heavy metals in ballast water from the ports of Calabar, Onne, and Warri, Nigeria, using local clay as a treatment method. The research focused on major ports within the Niger Delta region, where ballast and surface seawater samples were collected. of the ballast waters, and design and implement a ballast water treatment process using locally sourced clay soil from Delta State as a filtration material. The NESREA Act sets forth stringent regulations to control marine pollution (Ladan, 2012).By achieving these objectives, the research seeks to understand the environmental impact of ballast water discharges and explore potential treatment methods to mitigate these effects, thereby protecting the region's unique ecosystem.

METHODOLOGY

The research areas include three major ports namely the Calabar, Warri and Onne sea ports strategically located within the Niger Delta region of Nigeria.Sampling Methods

Ballast as well as surface seawater sampling was conducted in the main ports of the Niger Delta, including Warri, Onne, and Calabar Ports. These ports are the primary and most extensive ports in Nigeria. The samples were collected in plastic containers that were washed with non-ionic detergent. They were then rinsed with tap water, and again with de-ionized water before being used. Grab samples were collected at the ports, combined to create a composite sample, and routinely stored in a refrigerator at about $4^{o}C$ before analysis. Samples were designated (BWC, SWC, BWO, SWO, BWW, SWW). Where BWC=Ballast Water Calabar, BWO=Ballast Water Onne, BWW= Ballast Water Warri, SWC=Surface Water Calabar, SWO=Surface Water Onne, SWW= Surface Water Warri.

Transportation of Samples and Pre-treatment

Following Guidelines G8, samples were analyzed promptly after sampling, within 6 hours, and preserved appropriately to maintain the integrity of the organisms and enable accurate analysis (Gollasch & Kacan, 2015). The collected samples were delivered to the laboratory in accordance with the D-2 standard. Watertight sample vials were utilized to prevent water seepage during transportation. The samples were transported in Styrofoam cartons to prevent abrupt temperature fluctuations (Gollasch & David, 2011). The samples were stored at a temperature differential of 10–15 °C between the ambient sampling conditions and during storage. This was done to prevent possible temperature shock and stress generated by warm atmospheric condition (Gollasch & Kacan, 2014).

High-purity analytical grade reagents were used, including HNO_3 (69% LR, Breckland Scientific Supplies, U.K), for sample preservation before analysis. Only distilled water was utilized in the experiment to create the solutions. For the metal analysis process, atomic absorption spectroscopic standard solutions with a concentration of 1000 mg L^{-1} (Buck Scientific) were utilized to create intermediate and working standards.

The intermediate standards were created using the dilution procedure. The working standard solutions were freshly created by diluting the intermediate standards with distilled water. The heavy metals (Hg, Fe, As, Zn, Cu, Cd, and Ni)

were examined using a flame atomic absorption spectrometer (FAAS) with calibration curves. Prior to analysis, the instrument parameters (lamp alignment, wavelength and slit width adjustment, and burner alignment) were fine-tuned to enhance signal intensity and sensitivity. The quantification of heavy metals was performed using the Agilent 55AA Flame Atomic Absorption Spectrometer (FAAS).

Ballast Water Treatment System

The materials consist of untreated clay (NT) collected from Udu area in Aghalokpe town, Delta State, Nigeria, which was treated with hydrochloric acid (HCl) and labelled as (AT). A solution was prepared by dissolving 50 g of NT in 100 millilitres of 4N HCl solution. The mixture was agitated for 1 hour and then left undisturbed for 24 hours. Finally, it was decanted and rinsed extensively with distilled water. The filtrate was dehydrated in an oven at 140 °C for 4 hours. The material was cooled, ground, and sifted into particles measuring around 125 micrometres before being stored securely for future use.The Thermo Electron Nicolet 4700 FTIR spectrometer captured the spectra of the adsorbent with a resolution ranging from 4000 to 500 $cm^{-1.}$

The characteristics of the clay soil were analyzed using Thermo Scientific X-ray Fluorescence (XRF) spectroscopy. XRF analysis was conducted using the usual procedure using Montana soil SRM 2710 for Geological Sample and IAEA – 155. Weighed two grams of each sample and placed them in a sample holder, covering them with cotton wool to prevent splashing. The sample holders with the sample were evacuated using a vacuum pump for 10 minutes before being placed into the XRF Spectrometer for Elemental analysis. The procedure was calibrated using geological standards, and the analysis can be conducted in either elemental or oxide form. The samples were analyzed in the XRF spectrometer for 10 minutes each, and the findings were obtained (Ogundiran & Kumar, 2015).X-ray Diffraction (XRD) analyses were conducted using a PW2400 and MD 10 Randicon diffractometer, respectively.

RESULTS

The results from an X-ray diffraction (XRD) analysis of the clay soil us for the filtration process, specifically focused on determining the soil crystallite size, The crystallite sizes of the clay particles, calculated for the different peaks, range from approximately 23.46 nm to 56.89 nm. The overall average particle size calculated is approximately 46.62 nm. This indicates that the clay sample consists of nanosized crystallites, which can affect its physical and chemical properties.

Table 1: Concentrations of Heavy Metals in Ballast Water before Treatment in studied Ports (mg/L)

Element/ Samples	Pb (mg/L)	Hg (mg/L)	Fe (mg/L)	As (mg/L)	Zn (mg/L)	Cu (mg/L)	Cd (mg/L)	Ni (mg/L)
BWC	0.279±0.120	ND	0.66±0.30	ND	0.83±0.22	1.06±0.035	0.018±0.00	0.83±0.22
BWO	0.294±0.006	ND	0.96±0.00	ND	1.08±0.00	1.18±0.00	0.002±0.00	0.65±0.820
BWW	0.235±0.036	ND	1.95±0.58	ND	2.75±0.141	2.26±0.92	0.071±0.005	2.67±0.07
IMO Guidelines	≤0.250	≤0.0007	-	≤0.050	≤0.200	≤5.00	≤3.00	≤50
NESREA	≤1 µg/L	≤0.05 µg/L	-	≤20 µg/L	≤20 µg/L	≤5 µg/L	≤1 µg/L	-

ND = Not Detectable; BWC=Ballast Water Calabar, BWW= Ballast Water Warri, BWO= Ballast Water Onne; IMO = International Maritime Organization; NESREA (National Environmental Stand

Table 1 presents the concentrations of various heavy metals in ballast water samples collected from three ports: Calabar (BWC), Onne (BWO), and Warri (BWW). The analysis of ballast water from the ports of Calabar, Onne, and Warri reveals significant heavy metal concentrations that exceed the established guidelines. Specifically, lead concentrations are 0.279 mg/L in Calabar, 0.294 mg/L in Onne, and 0.235 mg/L in Warri, all of which surpass the NESREA limit of 0.001 mg/L and the IMO limit of 0.250 mg/L. Zinc levels are also high, with 0.83 mg/L in Calabar, 1.08 mg/L in Onne, and 2.75 mg/L in Warri, exceeding both the NESREA limit of 0.02 mg/L and the IMO limit of 0.200 mg/L. Copper concentrations are 1.06 mg/L in Calabar, 1.18 mg/L in Onne, and 2.26 mg/L in Warri, far exceeding the NESREA limit of 0.005 mg/L, though within the IMO limit of 5.00 mg/L. Cadmium levels, at 0.018 mg/L in Calabar, 0.002 mg/L in Onne, and 0.071 mg/L in Warri, also surpass the NESREA limit of 0.001 mg/L but are well within the IMO limit of 3.00 mg/L. Mercury and arsenic were not detectable in any samples, indicating compliance with the guidelines from both

IMO and NESREA. The iron concentrations are 0.66 mg/L in Calabar, 0.96 mg/L in Onne, and 1.95 mg/L in Warri, and nickel concentrations are 0.83 mg/L in Calabar, 0.65 mg/L in Onne, and 2.67 mg/L in Warri. These values are within the IMO limits, and there are no specified limits for iron and nickel from NESREA. Overall, the findings suggest a substantial presence of heavy metals in the ballast water, necessitating further treatment and mitigation measures to comply with the stricter NESREA guidelines and to reduce potential environmental hazards (Salleh et al. (2021).

Table 2: Mean Concentrations of Heavy Metals in Ballast Water after Treatment with Clay (n=3)

Element/ Samples	Pb (mg/L)	Hg (mg/L)	Fe (mg/L)	As (mg/L)	Zn (mg/L)	Cu (mg/L)	Cd (mg/L)	Ni (mg/L)
BWC	0.172±0.01	0.0001±0.00	0.449±0.01	ND	0.214±0.001	1.009±0.01	0.002±0.001	0.664±0.01
BWO	0.278±0.01	0.0001±0.00	0.489±0.01	ND	0.911±0.001	1.009±0.01	0.002±0.001	0.013±0.01
BWW	0.242±0.01	0.0001±0.00	1.204±0.01	ND	1.114±0.01	2.706±0.01	0.005±0.001	0.423±0.01
IMO Guidelines	≤0.250	≤0.0007	-	≤0.050	≤0.200	≤5.00	≤3.00	≤50
NESREA	≤1 µg/L	≤0.05 µg/L	-	≤20 µg/L	≤20 µg/L	≤5 µg/L	≤1 µg/L	-

ND = Not Detectable; BWC=Ballast Water Calabar, BWW= Ballast Water Warri, BWO= Ballast Water Onne; IMO = International Maritime Organization; NESREA (National Environmental Standards and Regulations Enforcement Agency)

Table 2 presents results of the analysis of ballast water from the ports of Calabar, Onne, and Warri after treatment with clay reveals notable changes in heavy metal concentrations. Lead concentrations are 0.172 mg/L in Calabar, 0.278 mg/L in Onne, and 0.242 mg/L in Warri. While the Calabar sample now meets the IMO limit of 0.250 mg/L, the Onne and Warri samples still exceed this limit. All samples remain above the NESREA limit of 0.001 mg/L. Mercury concentrations are 0.0001 mg/L in all samples, which are well below both the IMO limit of 0.0007 mg/L and the NESREA limit of 0.00005 mg/L.

Iron concentrations are 0.449 mg/L in Calabar, 0.489 mg/L in Onne, and 1.204 mg/L in Warri. There are no specific guidelines from IMO or NESREA for iron concentrations in ballast water. Arsenic was not detectable in any of the samples, indicating compliance with both IMO and NESREA guidelines.Zinc levels are 0.214 mg/L in Calabar, 0.911 mg/L in Onne, and 1.114 mg/L in Warri. The Calabar sample meets the IMO limit of 0.200 mg/L but exceeds the NESREA limit of 0.02 mg/L. Both Onne and Warri samples exceed both the IMO and NESREA limits. Copper concentrations are 1.009 mg/L in Calabar and Onne, and 2.706 mg/L in Warri, all within the IMO limit of 5.00 mg/L but exceeding the NESREA limit of 0.005 mg/L.

Cadmium levels are 0.002 mg/L in Calabar and Onne, and 0.005 mg/L in Warri, which, while within the IMO limit of 3.00 mg/L, exceed the NESREA limit of 0.001 mg/L. Nickel concentrations are 0.664 mg/L in Calabar, 0.013 mg/L in Onne, and 0.423 mg/L in Warri, all within the IMO limit of 50 mg/L. NESREA does not specify a limit for nickel. The results indicate that the clay treatment has reduced the concentrations of some heavy metals, bringing some within the IMO guidelines (IMO, 2004; Jang, et al., 2020).), but further reductions are necessary to meet the stricter NESREA guidelines and mitigate potential environmental hazards.

Table 3: Percentage Removal of Heavy Metals from Ballast Water after Treatment with Local Clay

Element	Location of port/ percentage reduction in heavy metal conc.		
	BWC (%)	BWO (%)	BWW (%)
Pb	38.35	5.44	-2.98
Hg	0.00	0.00	0.00
Fe	31.97	49.06	38.26
As	0.00	0.00	0.00
Zn	74.22	15.65	59.49
Cu	4.81	14.49	-19.73
Cd	88.89	0.00	92.96
Ni	20.00	98.00	84.16

BWC= Ballast Water Calabar BWO = Ballast Water Onne, BWW = Ballast Water Warri,

The analysis of the percentage removal of heavy metals from ballast water after treatment with local clay reveals varying degrees of effectiveness across different ports and elements. For lead (Pb), there was a 38.35% reduction in Calabar, a minimal 5.44% reduction in Onne, and an unexpected increase of 2.98% in Warri. Mercury (Hg) showed no reduction in any of the ports, with 0.00% removal across Calabar, Onne, and Warri. Iron (Fe) reductions were 31.97% in Calabar, 49.06% in Onne, and 38.26% in Warri, indicating significant but variable effectiveness. Arsenic (As) removal was also 0.00% in all ports, indicating no detectable change. Zinc (Zn) reductions were substantial in Calabar at 74.22%, moderate in Onne at 15.65%, and significant in Warri at 59.49%. For copper (Cu), there was a minor reduction of 4.81% in Calabar, 14.49% in Onne, and a notable increase of 19.73% in Warri, indicating inefficacy or possible contamination in the latter.

Cadmium (Cd) removal was highly effective in Calabar and Warri, with reductions of 88.89% and 92.96%, respectively, while Onne showed no reduction at 0.00%. Nickel (Ni) reductions were 20.00% in Calabar, a highly effective 98.00% in Onne, and 84.16% in Warri. The treatment with local clay demonstrated variable effectiveness, with notable reductions in some metals such as zinc and cadmium, while showing limited or no effectiveness in others such as mercury and arsenic. Further optimization of the treatment process may be necessary to achieve more consistent and comprehensive removal of heavy metals across different ports and elements.

CONCLUSION

Ballast waters in the Niger Delta do not fully comply with IMO D1 regulations. Untreated discharges pose risks of eutrophication, biodiversity alteration, pollutant bioaccumulation, and the spread of invasive species and pathogens (IMO, 2004; Osuji& Agbakwuru, 2022). According to the NESREA Act (Ladan, 2012), compliance with marine pollution standards is critical for environmental protection in Nigeria.Implementing stricter ballast water discharge regulations and exploring affordable treatment alternatives, like using local clay, are crucial for protecting Nigeria's marine ecosystem.Nigeria cannot afford to neglect its marine environment. Pollution of the marine environment with heavy metals will be detrimental to both the health and economic development of Nigeria (Pona et al. (2021). The study recommends implementing more stringent restrictions on ballast water discharges to safeguard Nigeria's marine ecosystem. Exploring affordable ballast water treatment alternatives, such as using local clay, is essential. Additionally, further studies are required to establish the efficacy of local clay soil for treating ballast water before it is discharged into the environment. This approach aims to ensure that ballast water discharges do not lead to eutrophication, biodiversity alteration, pollutant bio-accumulation, or the spread of invasive species and pathogenic microbes in the Niger Delta.

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Appendix

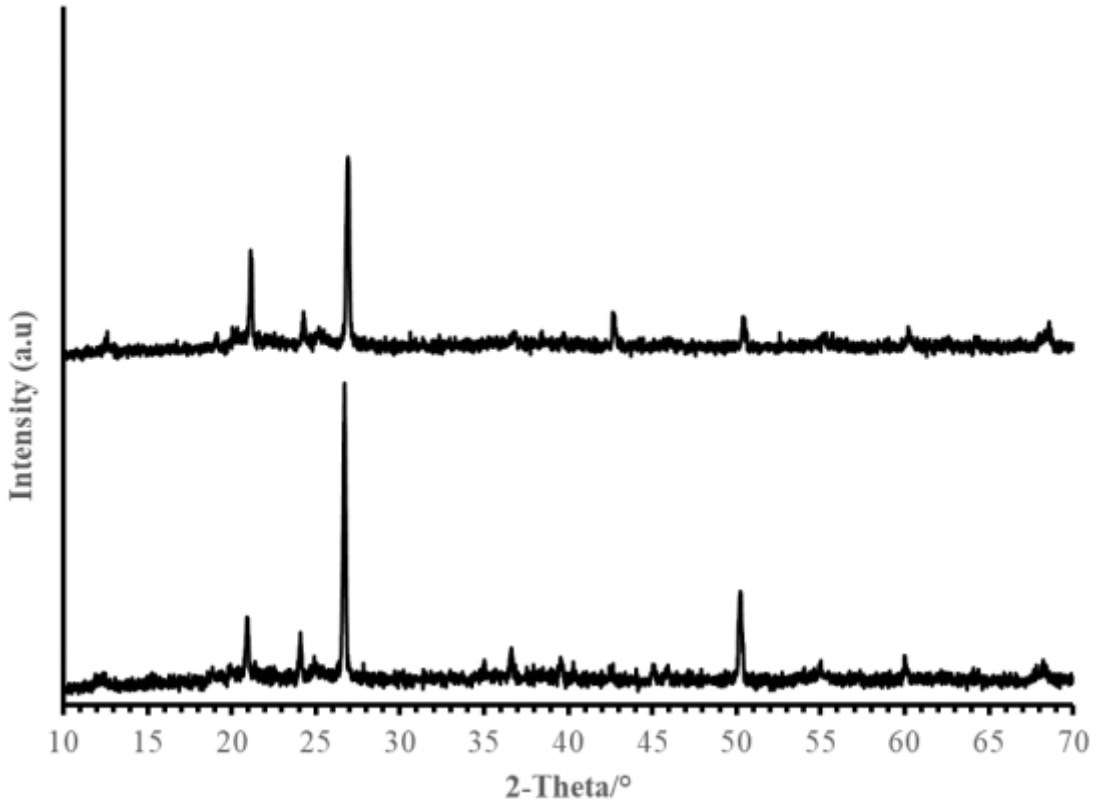

Figure 1. X-ray diffraction patterns of Natural Clay

Different peaks observed in the Clay XRD pattern

2-Theta °	FWHM	Theta	COS-Theta	FWHMrad	Size
19.14	0.14	9.57	0.986083222	0.002443784	55.92602888
21.16	0.14	10.58	0.9829995	0.002443784	55.75113462
24.29	0.16	12.145	0.977618301	0.002792896	48.51519589
26.91	0.17	13.455	0.972552968	0.002967452	45.42477566
36.86	0.16	18.43	0.948710608	0.002792896	47.08062538
42.66	0.13	21.33	0.931500902	0.002269228	56.89424995
50.41	0.18	25.205	0.904789893	0.003142008	39.91201778
55.12	0.30	27.56	0.886526805	0.00523668	23.46383877
					46.62098337

size = Kλ/βcosθ

K=0.9

β = FWHM

λ = 1.54 Å = 0.154 nm

Particle size = 46.62 nm

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Full Length Research

Scientific explanatory note on human abnormal sexual affairs: for repositioning gender studies for sustainable youth

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This paper presents scientific explanatory note on human abnormal sexual affairs: for repositioning gender studies for sustainable youths issues discussed are (i)Concept of normalcy in sex (ii)Concept of law in sex (iii) Sexual problems and other legal ramification (iv) Sexual inadequacy (v) Causes impotence, types, origin, defects and treatment (vi)Frigidity(vii)Hyper sexuality (viii)Prostitution (ix)Pornography (x) group sex rape and sexual perversion. Based on the review, it was concluded that divorce imprisonment, separated families are some of the resultant factors of sexual inadequacies prevalent among Nigerians. It was recommended that Homosexuals could be prevented by (a) Avoiding older, over affectionate, possessive or solicitous persons of the same sex (b) Avoiding acting dressing or thinking like opposite sex (c) Removal of incestuous partner from the vicinity (d) Sex education (Health Communication and Health counselling)In the case of parent to children psychopathology is required.

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INTRODUCTION

Having sexual intercourse with Cows, Cats and dogs is reported among human males and females in this century. Laymen term this act as sign of madness and these deviation signs had cause quarrelling within couples to the extent of divorce but psycho-analyst term it as simply deviation in choice of sexual object and not madness. But unless husbands and wives are vast in sex education, there would always be problems. The human abnormal sexual behaviour shall be classified as follows:- (a). Deviation in choice of sexual object (b)Deviation in choice of sexual aim (c)deviation in choice of sexual object and (d) Masturbation (onanism auto-erotic).All the sexual problems and inadequacies constitute public nuisance and also cause plenty of abuses, cursing, wailing and husband's brutality. Normalcy is a standard of how a person ought to behave Normal behaviour emphasizes rationality and exercise of self-control. Mental illness is a deviation from normalcy. It is a condition in which rationality and the exercise of self-control. Mental illness is a deviation from normalcy. It is a condition in which rationality is impaired, and it is assumed that the person has lost control of his behaviour and as such is no longer responsible (Adeboye 2002). Impairment in sexual life is also a deviation from normal living. Impairments different to discern in the course of treating sexual inadequacy public is not only tort: it is also a crime. The sexual offences act or law covers a multitude of sins (http://en.wikipedia.org/wiki/prostitution).

Purpose of Study

The community demands comprehensive knowledge of sexual inadequacies to prevent unwanted pregnancy procreation of illegal children, divorce, rape and sex with lower animals and unapproved object. To sensitize teachers on the need to teach sex adequately, to enable government recognize the value of health education as a core subject within which sex education is taught from nursery to the University. The following are some of the prevailing sexual inappropriateness within the community that causes problems to the comfort of the populace:

Table 1. An overview of various forms of education in sexual object and choice of sexual aim human

Labelling	Concept	Observable within the environment	Attraction to the law	The intrinsic and extrinsic possible physiological effect
				Harmful to self and others
Deviation in choice of sexual object				
Masturbation	Sexual gratification through self-stimulation	No	No	No? effects unknown.
Homosexual	Sexual relation between members of the same sex	No	Law varies	Yes? Can be infect with HIV
Paedophilia	Sexual activities imposed on a child by an adult	Relatively rear	No	Yes often has no child
Incest	Sexual relations between close family member (blood relations)	Very rare	Yes	Yes, also harmful if it involves and adult and a child.
Bestiality	Sexual contact with animals	Relatively rare	No	Yes? Debasing
Fetishism	Using an object (fetish) as a primary source of sexual arousal and gratification	Relatively rare	No?	NO?
Transvestism	Sexual stimulation by wearing clothes of opposite sex	Relatively rare	Legal when making public nuisance of self	No?
Trans-sexuality	Conscious compelling desire to think, feel and act like the opposite sex or to change ones sex	Common	Legal	No?
Deviation in choice of sexual aim				
Voyeurism	Secret observation of individuals undress or having intimate intercourse	Relatively rare	No	Yes
Exhibitionism	Exposing genital to others	Common sex offence	Yes	Yes
Sadism	Sexual gratification through inflicting pain and humiliation infliction on oneself or others	Relatively rare	No	Yes

Source: Nwachukwu A.T. (1994) A handbook of Abnormal Psychology and Health Education.

The information on this table indicates that deviations in sexual activities may occur either in the choice of the object (i.e the person who provides the sexual gratification) or in the choice of the aim (i.e what an individual wishes to do with the sexual object). For instance, homosexuality, which involves the choice of a sexual object of the same sex is a deviation in sexual object. Also exhibitionism is a deviation in sexual aim because it involves the exposure of the genitals. Although there are universally acceptable normal sexual inadequacies in heterosexual activity such as impotence, group sex or frigidity these are also seen as deviations. These sexual labelling are further discusses as follows:

Sexual Deviation

Sexual deviation is defined an aberrant sexual activity or expression of sexual instinct in practice which are socially prohibited or unacceptable or biological undesirable (Ogundele 2002) According to Masters and Johnson (2006),

Waught and Grant (2001). Masturbation is the self-stimulation of the sexual organs for sexual gratification where the masturbator is deprived of the female sexual organs. This act was common with intended spouses in the ancient time when suitors would deliberately avoid themselves due to taboo attached to sex before marriage, whereby females were taught several acts of avoidance of their suitors for fear of losing the first blood from their sex organ at the eve of their wedding (Omeje 2004). Misinterpretation of one's behaviour in the Old Testament led to its condemnation by religious authority. Masturbation became the subject of many myths and was blamed for such sexual act such weakness and insanity is due to punishment for sins several orthodox religious regard masturbation as sin.

According to (Oparah 2005), the Vatican and some other churches see masturbation as a seriously disordered act. Masturbation is accompanied by feelings of guilt and shame. In infancy and early childhood, masturbation is considered part of an instinctive search for pleasurable sensations similar to those resulting from exploration of other parts of the body e.g. finger, toes, etc. at puberty and during adolescence, masturbation indicates the emerging sexuality. It tends to be universally practiced before opportunities for mature sexual outlets appear. Masturbation may continue into married life and been into old age, especially if oth4er sexual outlets are limited or unavailable. Psychic masturbation is the ability to achieve sexual gratification by concentration on sexual fantasies. Masturbator needs treatment by reassurance counselling and education.

Homosexuality (Sodomy)

Sodomy refers to desire for sexual contact between persons of the same sex- Homosexual behaviour between women is referred to as lesbianism. Men and women who enjoy sexual contact with both sexes are named bisexual. Most bisexual are basically homosexual. No area of sexuality is surrounded by as many misconceptions as homosexuality (UNAIDS 2001).

The causes of homosexuality are related to;

1. Lack of other amorous outlets
2. Sexual inversion
3. Tendency to have higher proportion of estrogens (males)
4. The psychoanalytic explanation is based on the concepts of castration anxiety and Oedipus complex.

According to Ruth and Brecher (2006), OOMS (2002), (i) "regression to or fixation as a pregenital oral or anal psychosexual phase occurred after prolonged frustration with identification with the frustrating object" (ii) genetic and endocrine studies and physical examination have thus far failed to point out any biological and physical difference between homosexuals and heterosexuals. (iii) As long as the homosexual derive sexual gratification from their act: and constitute no nuisance in the society, such homosexual could be treated with psychoanalysis, or by behaviour therapy, group therapy and drug therapy. Both authorities postulated medical care coupled with all therapies mentioned above for chronic homosexuals.

Incest: According to Rachira (2003): (i) copulation with one's mother, sister, niece, nephew or any blood relations is what is termed incest. Sexual intercourse between brothers and sister, mother and son, daughter and father result into incestuous act. (ii) Being in close contact and outright display of faithfulness, pity and harmonious living induce people of the same blood relation into exploring themselves and therefore having sexual intercourse that may be termed incestuous at. And having cotus with cousins, aunts, sister could buttress soothing relationship and mutual understanding of such act could result into marital life. (Pelt 2002) saw the relationship as normal though he affirmed further that it could be an act frowned at by the society.

Further still, Melgosa (2002) confirmed that there existed various and divergent situations to consider when attempting to define incest. To him, it is a union, in sexual activity, intercourse or in marriage, of two individual of the oppose sex who stand in kin relationship (customary or legal) to each other, in response to human query and instinct, Moronkola (2003) said: firstly incest includes also homosexual activities between intra-family members. Almost all societies have taboos against sexual relations between closely related individuals, secondly, the origin and functional significance of the insect taboo are topics of long standing interest in secondary anthropology and psychology; because the ban against incest s one of the most stringent of sexual prohibition in all culture the world over.

It is viewed legally and morally as criminal and deviant behaviours; the punishment is severe especially when and adult incestuously victimizes child.

Thirdly, incest includes all forms of sexual contact, sexual exploration (through pornography etc) and sexual overtures initiated by adult who is related to the child by family ties or through surrogate family ties. Fourthly, due to social and legal taboos against incest, an individual who actually carries out an incestuous wish is usually suffering from ego defect and is often psychotic

Note:- prevention strategies for incest could include:-

i. Removal of incestuous partner from the vicinity
ii. Sex education (health communication and health counselling)
iii. In the case of parents to children, psychopathology is required

However, the oedipal incestuous striving of childhood gets gradually resolved and replaced by adult sexuality. While mild incestuous, behaviour in sibling is common in preadolescence as sex play. However, there existed adult uncles, cousins, nephews who take delight in having sexual affairs with little boys and girls. These categories are called paedophilia.

Paedophilia: Paedophilia refers to adult's use of children or minors for sexual pleasure and sexual satisfaction or sexual purpose. The deviants are usually adults as well as a relative, friend or neighbour of the child or minor, the paedophile hires the child/minor through friendly gifts advances or play or treats of offer, and sometimes use of threat or force. The sexual contact may consist of fondling, masturbation and other sexual contacts. Many deviants in this area are impotent, weak and psychologically inadequate. Paedophilia is a serious legal offence as the victimized children/minor or immature persons are frightened by the experience and the psychological effect of the act on them always traumatic (Morldy 2009).There are some men and women who are sub – normal; that derive sexual satisfaction in non – animate objects.

Fetishism:

The deviant masturbates looking at or handing the fetish object or even when fantasizing about the object. The fetish object could be pant, brassier or corset, a pair of shoes, the hair or garment of persons of the opposite sex, the fetish object seems to be associated with early sexual gratification. Fetishism may arise from limited relation with persons of the opposite sex or experiences of a humiliating nature. Also, frequently associated with fetishism is Voyeurism or piping tom, homosexually or compulsive masturbation, suggesting difficulties in heterosexual relations or in unavailability of opposite sexual partner or due to acculturation of sexual life or all or all of the above Masters and Johnson (2006) and Derek (2000). While some men and women prefer lower animals, cattle, cow, horse and donkey to have sexual affairs with them.

Bestiality (also called sodomy): This is the act of having sexual relations with living subhuman animals. Zoophile denoted sexual excitement through founding or stoking animals. Bestiality is a deviation the deviants are fond among boys raised in the farms and also men who spend most of their time with animal in remote areas. They may seek or have excitement or orgasm through sexual contacts with animals such as household pets and farm animals (Muragbo and Ubachukwu 2001). Farm animals are commonly used. This kind of sexual deviation tends to arise from deprivation of opportunities for sex love with other human deprivation of sexual play due to culture, spell of taboos or sex curiosity and loneliness.

Bestiality occurs in individual who have schizoid personality or are overtly intelligent and education people and people who are intoxicated many also practice bestiality. It occurs mostly at adolescence and then declines (Wikimedia Foundation 2006). There are also existed men and women who derive sexual satisfaction behaving like the opposite sex.

Transverses: This is a deviant found mostly among men. The men wear female dresses to arouse themselves or others. It is usually legal unless the transvestite makes himself of public nuisance. Transvestite are not homosexuals and transsexual. Some transvestites also have fetishist, homosexual or masochistic traits (Stoop and Stoop 2002). Deviation of choice of sexual aim includes: (i) vouyerism, exhibitism (ii) Trans – sexuality, in sadism and masochism

Voyeurism: According to Ruth and Brecher (2006) and Samuel (2006) voyeurism is likened to peeping tom who reached orgasm by compulsively and repetitively observing pornographic pictures, blue moves, naked women, or naked babies, etc. it is a deviation whereby an individual, especially the male prefers it to actual sexual contact. In classrooms or libraries voyeurs take positions where they can view the opposite sex through reflectors or mirror placed on the floor (Ruth and Brecher 2006). Voyeurs do not like to expose themselves to be seen by the persons they are watching. A typical voyeur has no serious emotional disturbance and major criminal record. He does not physically molest the women he watches. He does have no history of very limited and often unsatisfactory hetro sexual experiences (Samuel 2006).

Exhibitionism: It refers to deliberate and compulsive exposure of the genitals in pubic, almost always by a move to women and children as a means of achieving sexual gratification (Cobb 2001). An exhibitionist usually waits in an excluded place and exposes his penis when a woman passes. He waits for her reaction, which includes shock, disgust or running away. The object of his behaviour is attraction which he finds pleasurable and sexually exciting. He does not want the woman to become sexually interested in and would probably flee if she approached him (Brackenridge & Fasting 2006). It seems to be the most common sexual offence in Europe, Canada and the united states. In Nigeria exhibitionist have been observed at parks, colleges and pubic stadium and urban hide-outs. Most of the exhibitionist have been found to be immature, with sadistic and masochistic, tendencies, lacking in sexual completeness, shy and suffering from feelings or interiority complex in approaching the opposite sex (Mackenzie 2016).
The exhibitionist laterally demonstrates that he is a man, but in such a way that he does not have to prove it through physical intimacy in which he may be taught to be inadequate.
The psychoanalytic theory speculates that exhibitionism serves as a denial of castration anxiety. The male seeks reassurance from the reaction of the female audience, that he has a penis and that they fear him because of it. Exhibitionistic play is common in preadolescence and it is not a perversion (Masters and Johnson 2006).

Note: Exhibitionism can be treated with intensive psychotherapy in cases of chronic situation

Trans-Sexuality: A male transsexual is one who thinks, feels, acts like a female, but is biologically male (Darling and Steinberg 2000). This term trans-sexuality refers to the conscious competing degree to change one's sex. This is the same as the hermaphrodite who has biologic abnormality of inter sex (both sexes) hermaphrodites have sex role orientation appropriate to their predominant external sexual characteristics (Ruth and Brecher 2006).

However, one should note that most transvestites are not trans sexual, but most trans sexual wear the clothes of the opposite sex, as transvestites do at times, passive feminine homosexuality in the male trans sexual is usual, but most homosexuals have a normal gender role, although the object choice is reversed in most cases (Masters and Johnson 2006), sometimes an individual may become convinced he is actually changing sex, usually against his will. Such a person is psychotic, not a Trans sexual. In the same vien, Shorter (1997) confirmed that male transsexuals deliberately seek and obtain castration and female like organs on them Female Trans sexual seek and obtain mastectomy and prostheses.

Sadism and masochism: Sadism refers to obtained sexual arousal or gratification by inflicting pain or humiliation on the partner. Masochism refers to sexual pleasure derived from suffering humiliation or pain. The terms are derived from the Morque de Sade, a French writer and Leopold von sachet Masoch, an Austrian novelist who wrote on the subject. The two terms are referred to as sado masochism because they are always present together, with one or the other dominating. To Samuel (2010) (i) said that sadism and masochism are often exhibited discretely as sexual deviations. Here both sex and pain, eg. Biting the partner, performing flagellation or other physical assault become intricately associated with each other during sexual activity. (ii) However extreme sadistic acts are rape, killing and mutilating the corpse. The examples currently are husbands who stab their wives, cut the wives belly and spill the blood and the intestines; extreme sadism indicates psychosis or organic brain disease. (iii) Cruel acts like beating children severely; fantastical persecution indicate sadism. (iv) Excessive cruelty or cruelty on the part of men indicate impotency problem (v) sadomasochist often have experienced violence in their families during childhood, such as fathers brutalizing mothers, siblings or themselves. (vi) The masochists frequently feel depressed guilty and have low esteem, while the sadist tends to be domineering sarcastic and physically aggressive. Unless a man is castrated, constant production of androgen enhances sexual drive. In the same vein, oestrogen in the female signals sexual desire. At puberty, androgen and oestrogen/production levels of human male and female become matured and accelerated. A boy may thereafter experience nocturnal emission and subsequently masturbates. High level of estrogen engineers high sexual arousal in girls while low level of estrogen triggers low level of sexual arousal. Even at menopause, women who receive large amounts of testosterone or estrogen still enjoy sexual drive, stimulation and coitus. In men however, sex hormones influence sex drive, but do not control it. Even when their bodies are not producing substantial amount of androgen, early or later in a life cycle many males are sexually interested and active (Ruth and Brecher, 2006), Medicine Plus (2010).In normal male and female human therefore, if adequate testosterone or estrogen, androgen or progesterone levels are triggered off, there is the urge to engage in coitus precedes the other way round foreplay while the female reciprocate by posturing; then sexual intercourse could be accomplished. Often, males seek pleasure from sexual union though most of the times; they would prefer coitus for procreation and love although females could engage in sexual activity for money, wealth, affluence as in the case of prostitution. Beyond the reasons listen above, sexual deviants exist especially, among males – those whose aim of sexuality differ from the conventional reasons. (Akinade and Sulieman 2005) found out sexual deviations as follows;

Table 2: An overview of various forms of sexual problems and their legal ramification

Name	Definition	Statistical Prevalent	Legal ramification	Criteria for abnormality Harmful to self and others
Sexual inadequacies				
Impotence	The man have never or is unable to achieve sexual power. Inability to achieve or maintain an erection	Yes	Divorce	Yes, causes loss of self-esteem and frustration to mate
Premature or mental ejaculation	Early ejaculation or inability to achieve ejaculation or inability to ejaculate	Yes	Divorce	Yes, cause loss of self-esteem and frustration to mate
Hyper sexuality	Excessive and compulsive desire or engagement in sexual acts.	Yes	Divorce	Yes, cases loss of self-esteem sexual crimes may be committed
Frigidity	Partial or complete lack of sexual desires or gratification	Yes	Divorce	Yes, causes loss of self-esteem and frustration
Prostitution	Sexual relations for money or material wealth	Yes	Yes social and religion taboo	Yes self devaluation and alienation
Pornography	Literature dealing with the obscene aimed at arousing the reader or viewer sexually	Yes	Yes legal censorship	Effects remain unknown
Sex swamp or gang sex	Sex between three or more people at the same time	Apparently on the increase	Yes legal & religious social taboo	Yes self devaluation and disturbing
Rape	Sexual relation by force or threat	Somewhat rare	Yes animal offence	Yes

Source: Sexual deviation (www.performation.ng/prostitution/in/ng). A handbook of abnormal psychology and health education

Table 2 above indicates various forms of abnormal sexual behaviour in the manner at which sexual gratification is either initiated or accomplished. Premature or mental ejaculation of spermatozoa for example may leave the sexual partner unsatisfied and in the case of pregnancy search, the sperms that is required to join the ovum may not have that chance of fertilizing an egg.

Sexual inadequacy, causes and treatment

Sexual inadequacy are: impotence that may be caused by organic, toxic factor and psychological factors impotence occurs in only males and can be defined as unsatisfactory performance in sexual relationship which includes inadequacies, such as inability to achieve sexual powers to attain erection, a semi-erection, inability to sustain erection following penetration of the female, failure to ejaculate, premature ejaculation and general apathy. Impotence may be mild and transient or severe and prolonged (Ruth and Edward 2006). The important types, causes, and treatment is organised and put into table as follows:

Table 3: Causes of impotence

Type	Origin	Defects	Treatment
Organic	Systemic	- Anaemic - Malnutrition - Severe infection - Uncontrolled diabetes mellitus - Hypothyroidism	Medical

	Neurologic	Disease of the sacral part of the spinal cord, caudal equine, loss of the anal reflex: Nerve damage caused by trauma, syphilis etc.	Medical
	Physiologic condition	- Exhaustion - Aging	Education & counselling
	Anatomic defects	- Traumatic or surgical loss of testes.	Medical
Toxic factors	Hormones	- Excessive use of estrogens	Medical & counselling
	Drugs	- Alcohol after periods of inebriation and prolonged use of antidepressants	Medical & counselling
Psychology factors	Mixed	Anxiety, shame, guilt, fear, anger, external realistic situations, internal moral and religious prohibitions	Counselling reassurance and education

Source: (Akinade and Suileman 2005). A handbook of abnormal psychology and education, Enugu, Chukson.

The table above indicates that sexual inadequacy (impotence) can be classified into three groups viz-a-viz organic factor group/type, toxic type/group/factors and psychological factors. It is observed that constant exhaustion, aging, fear, anger and religious prohibition contribute to factors causing importance in men.

Frigidity

The term frigidity refers to a number of sexual inadequacies, such as lack of sexual desire and failure to achieve orgasm. Frigidity is an aspect of impotence that is mostly applied to women. In addition to the general causes of impotence, frigidity may be as a result of inadequate stimulation or fore-play, fear of becoming pregnant, moral and religious attitude about sex and hostility to men in general (Sokoya, 1999). It can be treated medically, through cancelling; education and reassurance.

Hyper Sexuality

The term hypersexuality refers to excessive desire for or engagement in sexual acts which may occur in men or women (Nwachukwu, 1994).

Table 4: Hyper sexuality variables and implicative consequences

Type	Origin	Effects	Treatment
Organic	Lesson in limbic area of the train	May be caused by tumour or accidents etc.	Medical long term psychotherapy and education
Organic	Psychomotor epilepsy	Episodes of temporal seizure	Medical, long term psychotherapy
Organic	Decontrol syndrome	Physical brutality dipsomania	Medical, long term psychotherapy and education
Organic	Drugs hexamine, opiates, androgen	Incest and sexual urge	Medical, long term psychotherapy and education
Psychogenic	Psychiatric diseases	Organic brain syndrome manic depressive psychosis, schizophrenia.	Medical long term psychotherapy and education
	Personality disorders	Borderline, personality, sociopathic, personality, hysterical personality	Medical long term psychotherapy and education

Source: Adapted from Daviers(2018). A handbook of abnormal psychology and education, Enugu. Chukson International Press.

Table 4 above represents hyper sexuality variables and implicative consequences that exist within our community. Some of the dangerous hyper sexuality are the organic type which results in the control syndrome with the effects of physical brutality dipsomania that desire medical long term psychotherapy and education. Also, the psychogenic type that are psychiatric diseases due to organic brain syndrome, manic depressive psychotherapy and education. Patents inflicted with these types of hyper sexuality are mostly sadists and masochists; and therefore most killers of their spouses are in these categories.

SUMMARY

Scientific explanatory note on human abnormal sexual affairs as precursor's gender violence, sexual crimes, legal sanctions and therapeutic solutions had been examined through researchers review. Issues dealt with are: (i) sexual deviations in the choice of sexual object and (ii) Deviation in choice of sexual aim. Human sexual objects and sexual aim had been the cause of sexual violence due to the fact that non-specialists in health education take some measures appropriateness to identify human psychological malaise and sins against marriage. Husbands and wives engage in fights to the point of death due to lack of knowledge of sexual problems among human beings. The sadists and masochists abound in Nigeria with their violent characteristics. Several husbands and wives are ready psychotic use perfumes and money as human nature garnishment; these perfumes and the money are used efficiently to the extent that the community do not notice them as psychotic until they begin to exhibit their characteristics. Some deaths had been recorded within Nigerian nation.

CONCLUSIONS

Based on the review and the summary, it could be concluded as follows:- (i) father to daughter sexual affairs exist within the community; and this is called incest (ii) mother to son sexual affairs also exist called incest (iii) some men and women are sadists and masochists who wound themselves and cause injury to themselves before they enjoy sexual intercourse (iv) in a case whereby a normal girl meets with a masochist at his extreme violence, death results from their encounter. (v) Issue of masochist and sadism are very rampant in Nigeria environment unaware to non-sex educators. Therefore several sexual violence abide in Nigeria contemporarily. (vi) The law enforcement agents do not significantly discover sexual crime; neighbours are not talking, the victims do not talk either for fear of shame and cultural taboo and/or labelling of victims (vii) sex education is not taught from nursery school for the youths to comprehend the different sorts of sexual crimes, sexual offences, sexual extremes and sexual shames.

RECOMMENDATION

Based on the conclusion drawn, it could be recommended as thus:

1. From nursery school to university, sex education should be the general study like English language, mathematics, biology, chemistry and physics.
2. Parents should monitor their children to checkmate their sexual life.
3. Health educators, health counsellors should be trained to monitor the people's homes with the intent to monitor the sexual affairs of people.
4. Before marriages are consummated, mental health certificates should be screened. Such mental health certificate should be obtained from Government Hospitals to ascertain the mental health status of bride and groom.

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Evaluation of Leachate Contaminants from Dumpsites Environments on Groundwater Quality in the State Capitals in Niger Delta, Nigeria

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This study evaluates the environmental impact of leachate contaminants from dumpsites on groundwater quality in the state capitals of the Niger Delta region, Nigeria. Groundwater samples were collected from five selected dumpsite namely Uyo Dumpsite A, Ekeki Dumpsite B, Lemna Dumpsite C, Ikpoba Hill Dumpsite D, and Mile 3 Dumpsite E—during both the rainy and dry seasons. The study aimed to assess the physicochemical, biological, and heavy metal concentrations in groundwater, calculate the Leachate Pollution Index (LPI), and investigate the speciation of heavy metals in leachate samples. Results showed significant contamination, with LPI values ranging from 7.5 ± 0.2 (Ikpoba Hill Dumpsite D) to 13.0 ± 0.7 (Mile 3 Dumpsite E) in the dry season, indicating high to moderate pollution levels. The heavy metals detected included lead (Pb), cadmium (Cd), chromium (Cr), and mercury (Hg), with proportions of free ion lead (Pb^{2+}) at 60%, cadmium ($CdCl^{+}$) at 70%, and mercury (CH_3Hg^{+}) at 80%. Toxicity tests revealed that fish LC50 for groundwater samples ranged from 48 mg/L to 6 mg/L in leachate, far exceeding safe drinking water thresholds. The study highlighted the severity of groundwater contamination due to leachates, with implications for public health and the need for improved waste management and groundwater protection strategies. These findings underscore the urgent need for regulatory policies to mitigate the adverse effects of dumpsite leachates on groundwater resources in the Niger Delta region.

Keywords: Leachate, Groundwater Quality, Dumpsites, Leachate Pollution Index, Heavy Metals, Toxicity, Niger Delta

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INTRODUCTION

Waste generation and management present significant challenges globally, including in Nigeria, where poor waste management leads to environmental pollution. One major issue is the presence of unregulated dumpsites in residential areas, particularly in the Niger Delta state capitals. These dumpsites, often termed "illegal" by the government, contribute to pollution through leachates that seep from waste in dumpsites and landfills. The unregulated nature of waste disposal at these sites exacerbates the problem.

Statement of the Problem

In an effort to manage waste, designated dumpsites have been created in Niger Delta state capitals by the respective Ministries of Environment. However, leachates from these sites pose a pollution risk, especially to communities that rely on groundwater from boreholes and wells for drinking and other purposes. Groundwater quality is influenced by various human activities, including waste management practices and the seepage of leachates from dumpsites, which can impact public health and the environment.

Objectives of the Study

This study aims to evaluate the contaminants in leachates from dumpsites and their effect on groundwater quality in the Niger Delta state capitals. Specifically, it will focus on determining the speciation of heavy metals present in the leachate samples from the study area

Significance of the Study

This study is important as it highlights the impact of dumpsite leachates on groundwater quality in the Niger Delta region, addressing a key environmental and public health issue. By identifying contaminants in leachates and their effect on groundwater, the research fills a critical gap in waste management and pollution knowledge. The study also reveals seasonal variations in contamination levels, offering valuable insights for policymakers and environmental managers to develop targeted strategies for waste disposal and groundwater protection. This is particularly crucial for communities relying on groundwater for drinking, domestic, and agricultural use, emphasizing the health risks of contaminated water sources

METHODOLOGY

The methodology for this study was designed to evaluate the impact of dumpsite leachates on groundwater quality in selected state capitals of the Niger Delta region, Nigeria. Groundwater samples were collected from boreholes and wells located in close proximity to identified dumpsites during both the rainy and dry seasons to assess temporal variations in water quality. The selected dumpsites were Uto Dumpsite A, Ekeki Dumpsite B, Lemna Dumpsite C, Ikpoba Hill Dumpsite D, and Mile 3 Dumpsite E, situated in Uyo, Port Harcourt, and Warri. The samples were collected using clean, sterilized containers, ensuring that cross-contamination was avoided. A total of 10 groundwater samples were taken from each site, and the samples were immediately transported to the laboratory under controlled conditions for subsequent analysis.

In the laboratory, a range of physicochemical, biological, and heavy metal parameters were analyzed using standard analytical methods. The physicochemical properties analyzed included pH, total dissolved solids (TDS), electrical conductivity (EC), turbidity, and temperature. For biological contamination, the study measured coliform and pathogen levels, while the heavy metal concentrations assessed included lead (Pb), cadmium (Cd), chromium (Cr), and mercury (Hg). The leachate samples were also subjected to similar analyses. Additionally, the Leachate Pollution Index (LPI) was calculated for each dumpsite to assess the overall pollution level in both the rainy and dry seasons. The index was based on key parameters such as chemical oxygen demand (COD), biological oxygen demand (BOD), and the presence of toxic metals.

To complement the above analysis, heavy metal speciation in leachate samples was conducted to determine the forms of the metals present, as this can influence their mobility and toxicity. The speciation of lead, cadmium, chromium, and mercury was analyzed using atomic absorption spectrometry (AAS). Toxicity testing was also carried out using fish bioassays and Microtox EC50 tests to assess the biological impact of groundwater and leachate samples on aquatic life. These toxicity levels were compared with established safety thresholds to evaluate the potential risk to human and environmental health.

Data obtained from the analysis were subjected to statistical treatment using SPSS software, and the results were presented in tables and graphs for a comprehensive understanding of the contamination levels and their implications on groundwater quality

RESULTS AND DISCUSIONS

Table 1: Selected States and Capitals in the Niger Delta Region for the Study

State	Capital	Key Dumpsites Examined
Akwa Ibom	Uyo	Uyo Central Dumpsite, Itam Dumpsite
Bayelsa	Yenagoa	Ekeki Dumpsite, Amarata Dumpsite
Cross River	Calabar	Lemna Dumpsite, Watt Market Dumpsite
Delta	Asaba	Ogbeogonogo Market Dumpsite, Okwe Dumpsite
Edo	Benin City	Ikpoba Hill Dumpsite, Ugbowo Dumpsite
Rivers	Port Harcourt	Mile 3 Dumpsite, Rumuokoro Dumpsite

Table 2: Physico-Chemical Characteristics of Groundwater Samples during Rainy and Dry Seasons

Parameter	Rainy Season (Mean ± SD)	Dry Season (Mean ± SD)	WHO Standard
pH	6.5 ± 0.3	6.8 ± 0.5	6.5–8.5
Electrical Conductivity (µS/cm)	520 ± 25	680 ± 35	1000
Total Dissolved Solids (TDS, mg/L)	310 ± 20	480 ± 30	500
Nitrates (NO_3^-, mg/L)	55 ± 7	70 ± 8	50
Ammonia (NH_3, mg/L)	0.7 ± 0.1	1.1 ± 0.2	0.5

Table 3: Heavy Metal Concentrations in Groundwater Samples

Heavy Metal	Rainy Season (mg/L)	Dry Season (mg/L)	WHO Standard (mg/L)
Lead (Pb)	0.04 ± 0.01	0.07 ± 0.02	0.01
Cadmium (Cd)	0.018 ± 0.004	0.028 ± 0.006	0.003
Chromium (Cr)	0.08 ± 0.02	0.12 ± 0.03	0.05
Mercury (Hg)	0.004 ± 0.001	0.006 ± 0.002	0.001
Arsenic (As)	0.012 ± 0.002	0.014 ± 0.004	0.01

Table 4: Seasonal Variation in Physico-Chemical Parameters of Surface Water

Parameter	Rainy Season (Mean ± SD)	Dry Season (Mean ± SD)	WHO Standard
Dissolved Oxygen (DO, mg/L)	7.2 ± 0.4	4.5 ± 0.3	≥5.0
Biochemical Oxygen Demand (BOD, mg/L)	3.5 ± 0.2	5.8 ± 0.5	≤6.0
Chemical Oxygen Demand (COD, mg/L)	10.5 ± 0.7	18.6 ± 1.1	≤10.0
Total Suspended Solids (TSS, mg/L)	15 ± 3	32 ± 5	≤25.0
Phosphates (PO_4^{3-}, mg/L)	0.9 ± 0.2	1.5 ± 0.3	≤0.5

Table 5: Microbial Contaminants in Groundwater Samples

Microbial Parameter	Rainy Season (CFU/mL)	Dry Season (CFU/mL)	WHO Standard (CFU/mL)
Total Coliforms	160 ± 25	210 ± 35	0
Escherichia coli (E. coli)	45 ± 8	75 ± 12	0
Fecal Streptococci	105 ± 20	155 ± 28	0
Salmonella spp.	Detected	Detected	Not Detected

Table 6: Leachate Pollution Index (LPI) at Dumpsites

Dumpsite	LPI (Rainy Season)	LPI (Dry Season)	Pollution Category
Uto Dumpsite A	10.4 ± 0.5	12.6 ± 0.6	High Pollution
Ekeki Dumpsite B	9.2 ± 0.4	10.1 ± 0.5	Moderate Pollution
Lemna Dumpsite C	8.0 ± 0.3	9.0 ± 0.4	Moderate Pollution
Ikpoba Hill Dumpsite D	7.5 ± 0.2	8.5 ± 0.3	Moderate Pollution
Mile 3 Dumpsite E	11.5 ± 0.6	13.0 ± 0.7	High Pollution

Table 7: Speciation of Heavy Metals in Leachate Samples

Heavy Metal	Form in Leachate	Proportion (%)
Lead (Pb)	Free ion (Pb^{2+})	60
Cadmium (Cd)	$CdCl^{+}$	70
Chromium (Cr)	Cr(VI)	50
Mercury (Hg)	Methylmercury (CH_3Hg^{+})	80

Table 8: Comparative Toxicity Levels of Groundwater and Leachate Samples

Toxicity Test Parameter	Uyo Dumpsite A (Groundwater)	Uyo Dumpsite A (Leachate)	Threshold
LC50 (mg/L) - Fish	48	6	>100
Microtox EC50 (%)	25	2	>50

The pH of groundwater during the rainy and dry seasons falls within the permissible WHO standard of 6.5–8.5, indicating slight acidity near some dumpsites during the rainy season. This could be attributed to increased infiltration of acidic leachates during rainfall.

EC values are higher in the dry season, likely due to reduced dilution from rainfall and increased leachate concentration. Although the values remain below the WHO standard, the increase is significant and indicative of ionic contamination.

TDS levels are nearing the WHO threshold in the dry season, signaling the potential risk of high contaminant loads from the dumpsites. Nitrates and Ammonia: parameters exceed the WHO limits, especially during the dry season, posing health risks like methemoglobinemia (blue baby syndrome) and other nitrogen-related disorders. These elevated levels are linked to decomposing organic waste in the dumpsites.

The results for pH indicate that groundwater from areas near dumpsites is slightly acidic during the rainy season (6.5) and becomes closer to neutral in the dry season (6.8). This seasonal variation is likely caused by the dilution effect of rainfall during the wet season, which reduces the buffering capacity of the groundwater. Acidic conditions, however, may increase the solubility of heavy metals, making them more bioavailable and potentially hazardous (Longe & Balogun, 2010). The results align with findings by Akinbile and Yusoff (2011), who reported a similar pH trend in groundwater near waste dumps in Nigeria.

Electrical conductivity (EC) and total dissolved solids (TDS) showed higher values in the dry season, reflecting increased concentrations of dissolved ions due to reduced dilution. Although the levels are below WHO thresholds, the values are approaching critical limits, suggesting leachate infiltration. These findings corroborate the work of Eze and Okoye (2018), who observed higher EC and TDS in groundwater during dry seasons near dumpsites in Enugu State. Elevated nitrate levels above WHO limits in both seasons (55 mg/L in the rainy season and 70 mg/L in the dry season) raise serious health concerns, such as methemoglobinemia, particularly for infants. The presence of nitrates likely

originates from decomposing organic waste. Ammonia concentrations exceeding 0.5 mg/L, especially during the dry season, further suggest microbial decomposition of organic matter, consistent with findings by Onwughara et al. (2013).

Groundwater near Uto Dumpsite A and other locations shows concerning levels of lead, especially during the dry season. Chronic exposure can result in neurological and kidney damage.

Cadmium (Cd) levels significantly exceed WHO limits in both seasons, reflecting its leachate origin from batteries and electronics. The presence of Chromium (Cr) especially the toxic Cr (VI) form, suggests industrial waste contributions. Its dry season concentration highlights the cumulative effect of reduced groundwater flow. Both elements namely Mercury (Hg) and Arsenic (As) exceed safe limits, underscoring the need for remediation. Mercury is particularly hazardous due to its potential for bioaccumulation.

Heavy metal analysis revealed concerning levels of toxic elements such as lead (Pb), cadmium (Cd), and chromium (Cr), all of which exceeded WHO limits in both seasons. Lead concentrations were particularly high during the dry season (0.07 mg/L), reflecting the cumulative effects of leachate percolation. Chronic exposure to lead has been associated with neurotoxicity and developmental issues in children (Nduka et al., 2008). Similarly, cadmium levels (0.028 mg/L in the dry season) far exceeded permissible limits, likely originating from batteries, paints, and other electronic waste in dumpsites, corroborating the findings of Oluwande et al. (2003).

Chromium levels were elevated in both seasons, with a higher concentration during the dry season (0.12 mg/L). The presence of hexavalent chromium (Cr (VI)), a carcinogenic form, could have significant health implications. Mercury and arsenic levels, though lower than Pb and Cd, still surpassed WHO limits, indicating contamination from industrial and electronic waste. A study by Obasi and Akudinobi (2020) similarly reported elevated heavy metal concentrations in groundwater near dumpsites in southeastern Nigeria, emphasizing the environmental risks of unmanaged waste disposal.

Microbial contamination results showed alarmingly high levels of coliforms, *E. coli*, and fecal streptococci, with values significantly above WHO standards. Total coliforms were highest in the dry season (210 CFU/mL), likely due to reduced groundwater dilution and concentration of leachate. The detection of *E. coli* and *Salmonella spp.* in all samples is indicative of fecal contamination, which may result from direct leachate infiltration or poor sanitation practices near the dumpsites. This aligns with the findings of Longe and Kehinde (2005), who reported significant microbial pollution in groundwater near Lagos dumpsites.

High fecal streptococci levels further point to human and animal waste contamination, posing risks of waterborne diseases such as typhoid and diarrhea. These microbial contaminants are a major public health concern, as emphasized by Igbanoi et al. (2019), who highlighted the health implications of microbial leachate pollution in Nigeria.

Table 4 presents **Seasonal Variation in Physico-Chemical Parameters of Surface Water.** Dissolved oxygen (DO) levels in surface water were observed to decrease significantly during the dry season, falling below the WHO standard of 5.0 mg/L. This reduction may be attributed to elevated temperatures and reduced water volume, which enhance oxygen depletion processes such as microbial activity and organic decomposition. Studies by Ugbebor et al. (2019) similarly reported low DO levels during dry seasons in rivers near urban dumpsites, raising concerns about aquatic life sustainability. In contrast, rainy season values (7.2 mg/L) were above the WHO standard, indicating better water quality due to dilution and aeration from rainfall.

Biochemical oxygen demand (BOD) and chemical oxygen demand (COD) increased during the dry season, reflecting higher organic load and anthropogenic pollution. COD levels exceeded permissible limits during the dry season (18.6 mg/L), indicative of non-biodegradable pollutants entering the water bodies from dumpsites. Elevated phosphate levels, particularly during the dry season (1.5 mg/L), are attributed to runoff containing fertilizers and decomposing organic matter. Excessive phosphate concentrations can trigger eutrophication, leading to algal blooms and oxygen depletion, consistent with observations by Ihenyen and Uwaifo (2020

The Leachate Pollution Index (LPI) values in Table 6 reveal significant variations between the rainy and dry seasons across the selected dumpsites, with notable pollution categories ranging from moderate to high. The LPI is a composite index that quantifies the overall pollution potential of leachates based on several key parameters, such as chemical oxygen demand (COD), heavy metals, and ammonia nitrogen. According to the table, Uto Dumpsite A and Mile 3 Dumpsite E recorded LPI values indicative of high pollution during both seasons, with dry season values (12.6 and 13.0, respectively) being higher than rainy season values. This trend can be attributed to increased concentration of contaminants during the dry season, as reduced rainfall leads to limited dilution of leachates. These findings align with the study by Naveen et al. (2018), which highlighted seasonal concentration effects on leachate quality in unmanaged dumpsites in tropical regions.

In contrast, Ekeki Dumpsite B, Lemna Dumpsite C, and Ikpoba Hill Dumpsite D fall into the moderate pollution category, with dry season values consistently higher than those recorded during the rainy season. Lemna Dumpsite C exhibited the lowest LPI values among all sites (8.0 ± 0.3 in the rainy season and 9.0 ± 0.4 in the dry season), indicating relatively lower pollution potential. The observed seasonal variation in LPI values can be linked to the hydrological

effects of rainfall, which not only dilute contaminants but also facilitate the mobilization of pollutants into surrounding environments. These results corroborate the work of Kumar and Alappat (2005), who emphasized the influence of climatic conditions on leachate pollution indices in municipal solid waste dumpsites.

The high pollution indices at Uto Dumpsite A and Mile 3 Dumpsite E indicate severe contamination risks to surrounding soil and water resources, posing significant threats to public health and ecological systems. These sites may be characterized by improper waste management practices, including the lack of engineered liners and leachate collection systems, which facilitate the leaching of hazardous substances. Furthermore, the moderate pollution levels at Ekeki, Lemna, and Ikpoba Hill dumpsites still warrant concern, as prolonged exposure to even moderate contamination levels can lead to the gradual degradation of soil and water quality. As noted by Bashir et al. (2015), even moderately polluted leachates can introduce toxic metals and organic compounds into groundwater systems, contributing to long-term environmental damage.

The findings underscore the urgent need for interventions such as leachate treatment systems and the proper containment of waste to mitigate pollution risks. The development of sustainable waste management practices, informed by periodic monitoring of LPI values, can significantly reduce the adverse impacts of dumpsites on the environment.

Table 7 presents the speciation of heavy metals in leachate samples, revealing the dominant chemical forms and their respective proportions. Speciation, which refers to the chemical forms of an element, is critical in understanding the toxicity, mobility, and bioavailability of heavy metals in the environment. Among the metals analyzed, mercury (Hg) exhibited the highest proportion of its toxic form, methylmercury (CH_3Hg^+), at 80%. Methylmercury is highly neurotoxic and bioaccumulative, posing significant risks to both aquatic ecosystems and human health through the food chain. This finding corroborates previous studies, such as those by Boening (2000), which emphasized the environmental persistence and extreme toxicity of methylmercury in leachates from improperly managed waste sites.

Lead (Pb), found predominantly as the free ion Pb^{2+} at 60%, is known for its mobility in aqueous environments, particularly in acidic leachates. The presence of Pb^{2+} highlights the risk of groundwater contamination since free ionic forms are readily absorbed by soil and aquatic organisms. This supports the findings of Alloway (2013), which noted that the speciation of lead in leachates often dictates its potential to contaminate water sources, especially in areas near unregulated dumpsites.

The high proportion of cadmium (Cd) as $CdCl^+$ (70%) and chromium (Cr) as Cr (VI) (50%) further underscores the environmental and health hazards posed by leachates. Cadmium in its $CdCl^+$ form is highly soluble, enhancing its transport potential into groundwater. Chronic exposure to cadmium, even at low concentrations, has been associated with kidney dysfunction and bone demineralization (Jarup & Akesson, 2009). Chromium in its hexavalent state (Cr(VI)) is highly toxic and carcinogenic, making its presence in dumpsite leachates particularly alarming. Its mobility and oxidation state are influenced by the pH and redox conditions of the dumpsite environment, as highlighted in studies by Rai et al. (1987).

The results from this table indicate that the composition of leachates from dumpsites is heavily influenced by the types of waste deposited, as well as the physicochemical conditions within the dumpsite. These factors facilitate the release of heavy metals in their most toxic forms, raising serious concerns about their migration into groundwater systems and subsequent ecological impacts.

The predominance of toxic heavy metal species in leachate underscores the need for stringent waste management practices, including the segregation of hazardous waste and the implementation of engineered landfill systems with leachate collection and treatment. Regular monitoring of heavy metal speciation in leachates is essential to prevent the bioaccumulation of toxic metals in the food chain and to protect human health. Further research into effective remediation techniques, such as chemical precipitation and advanced oxidation processes, could help mitigate the risks associated with heavy metal contamination

Table 8 provides a comparative analysis of the toxicity levels between groundwater and leachate samples from Uyo Dumpsite A, using two toxicity test parameters: LC50 (Lethal Concentration for 50% mortality in fish) and Microtox EC50 (effective concentration causing a 50% reduction in light emission in bioluminescent bacteria). The results show a significant disparity in toxicity levels, with the leachate samples exhibiting much higher toxicity than the groundwater samples.

For the LC50 parameter, the groundwater sample had a value of 48 mg/L, while the leachate recorded a much lower value of 6 mg/L. This indicates that the leachate is substantially more toxic to aquatic organisms, with the LC50 value falling well below the acceptable threshold of >100 mg/L. The elevated toxicity of the leachate can be attributed to the high concentration of contaminants, including heavy metals and organic pollutants, as reported in studies like those of Koshy and Vasudevan (2021). Such high toxicity in leachate is concerning because it suggests the potential for bioaccumulation and biomagnification in aquatic ecosystems if the leachate infiltrates surface water bodies.

The Microtox EC50 values also underscore the greater toxicity of the leachate compared to the groundwater. The leachate had an EC50 of 2%, far below the threshold of >50%, indicating extreme toxicity. In contrast, the groundwater

sample had an EC50 of 25%, which, while less toxic, still raises concerns about potential sub-lethal effects on microorganisms and aquatic life. These findings are consistent with those of Owamah et al. (2014), who observed that leachates from unregulated dumpsites often exhibit acute toxicity due to high concentrations of ammonia, heavy metals, and persistent organic pollutants.

The study reveals a disparity in toxicity levels between groundwater and leachate samples, suggesting that natural attenuation or dilution occurs as leachates move through soil layers before reaching groundwater. However, the residual toxicity in groundwater near dumpsites is a significant concern, as prolonged exposure to even low levels of toxic substances can lead to chronic health issues, particularly in vulnerable populations. The extreme toxicity of the leachate underscores the need for proper leachate management at dumpsites, including the use of impermeable liners and leachate collection systems. The results highlight the importance of sustainable waste management practices, including waste segregation, leachate treatment, and regular monitoring of dumpsite emissions. Implementing engineered landfills with leachate treatment facilities is crucial to prevent toxic contamination of groundwater and protect public health

CONCLUSION

This study evaluated the impact of leachate contaminants from dumpsites on groundwater quality in selected state capitals of the Niger Delta region. The results revealed significant contamination, with elevated levels of heavy metals (such as lead and mercury), organic pollutants, and microbial contaminants exceeding safe drinking water limits. These contaminants were more concentrated in leachate samples than in groundwater, suggesting that natural processes help reduce contamination levels. However, residual toxicity in groundwater poses a health risk to nearby communities. The findings highlight the need for improved waste management practices and the protection of groundwater resources.

RECOMMENDATIONS

To mitigate leachate contamination, it is recommended that the Niger Delta region adopts proactive waste management strategies, including engineered landfills with leachate collection and treatment systems. Periodic groundwater monitoring should be implemented to detect early contamination, and advanced treatment methods like bioremediation and reverse osmosis should be explored. Public education campaigns on proper waste disposal and source separation are essential. Strict environmental regulations and penalties should be enforced, and waste-to-energy projects should be promoted to reduce waste volume and provide alternative energy. These actions are crucial for improving groundwater quality and ensuring environmental and public health sustainability in the region.

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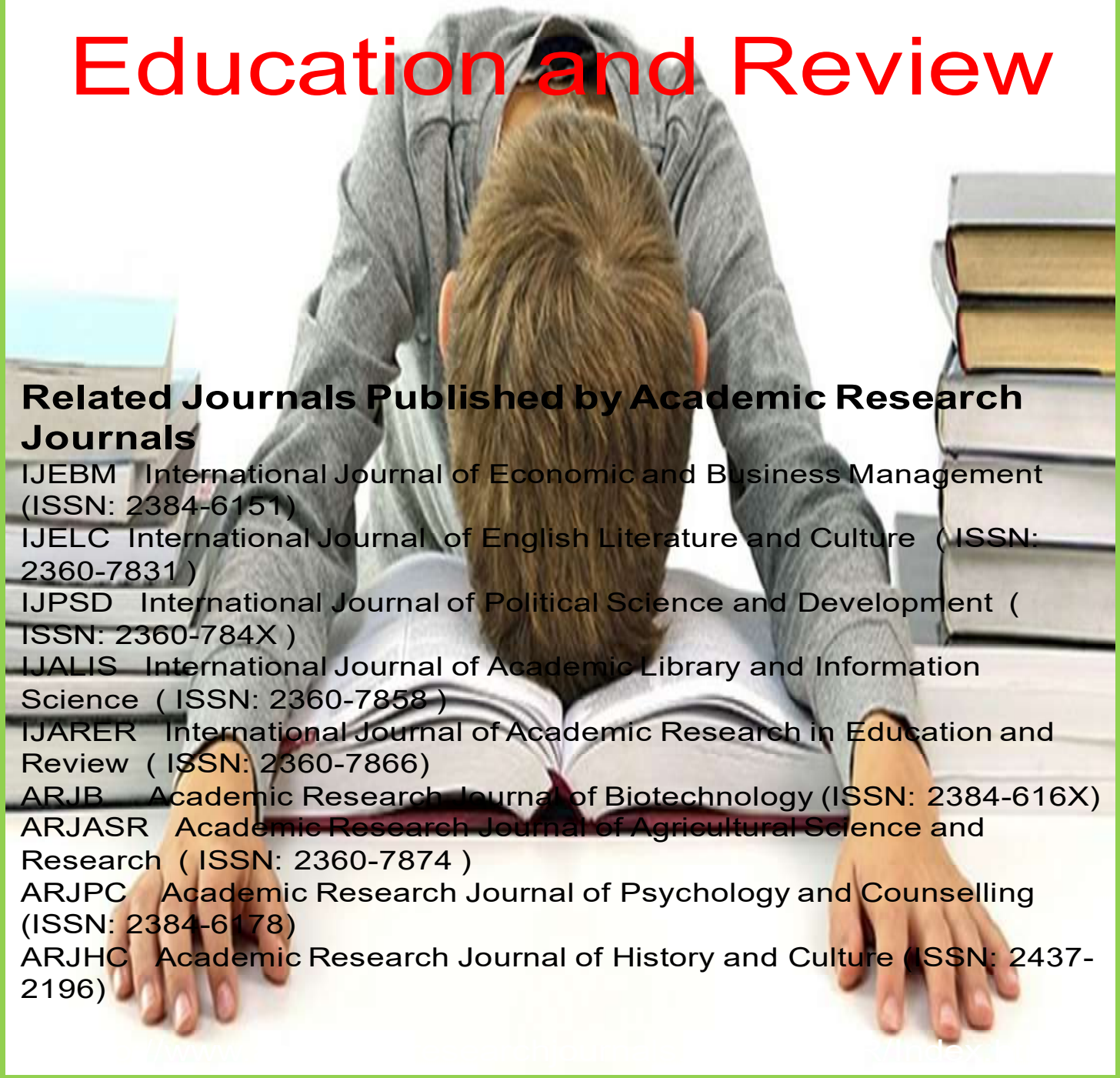

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