ISSN: 2756 - 6749

RIMA INTERNATIONAL JOURNAL OF EDUCATION

Vol. 3 (Number 3) November, 2024

Published by:
Faculty of Education,
Sokoto State University,
Sokoto, Nigeria

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TABLE OF CONTENTS

Rima International Journal of Education (RIJE), Vol. 3 (No. 3): Nov 2024; page: 1-17 ISSN: 2756 - 6749

Exploring the Design and testing of an off - screen Educational Robotics curriculum for early Childhood STEM Teachers in Plateau State

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Abstract

An experimental research design was used to design and test Educational Robotics (ER) curriculum for pre-service teachers in Federal College of Education Pankshin. The population for the study consisted of all NCE one students in the department of early childhood offering the course Science Technology Engineering and Mathematics STEM (ECE 124) in the 2023/2024 session. A Sample of 60 Pre service NCE teachers were selected. A robot car was constructed low cost kits in the robot design stages. The instruments used were the Robot Parts test (which will assess robotics knowledge) and secondly the Solve-Its tasks (which will assess robots design competence). Treatment lasted for 4 weeks. Data was collected and analysed using descriptive and inferential statistics. Results indicated that 50% of our participants did greatly in identification, 10% had never seen some of the components and a 55% has ever use the components in this project exercise. This implies that pre-service teachers are novice to robot part and use Also, participants were very competent in robot design process activities and robot base cutting. Participants also showed average competence in Robot stage cutting, construction of rollers and fixing of robot parts. They however showed only fair competence in coupling of robots parts. Findings indicate that the teachers designed robots have high educational value and are age appropriate. The robots are averagely complete in form, ease of use motion and durability. The designs however have low compliance to safety. It was recommended amongst other that Teacher training colleges should organised in-service training to improve teacher competent in handling engineering and technology parts and programming of STEM robots.

Key Words: STEM Educational Robotics curriculum, Robots Design, Robots Testing

Introduction

The problem of neglect of the T and E aspects of Science Technology and Engineering (STEM) at the early childhood levels of education in African countries and especially Nigeria due to teachers' low capacity to engage lower level learners with the engineering and technology aspects of the STEM curriculum is worrisome. Also, innovative and play based technology materials and curriculum seems not to have been given the right place in Nigerian early Childhood STEM teaching

and learning (Katniyon, *et al,* 2023). As discovered by Cirfat, et al. (2022) this situation is further compounded by lack of electricity and power in rural and urban schools for on screen educational robotics learning in Nigeria. One tangible innovation and play based way that children can engage with both T and E concepts of STEM during the early childhood years especially in countries that have electricity challenges like Nigeria is through off- screen educational robotics.

According to Lerch (2018), educational robotics are programmable machines or gadgets that are used in performing a range of tasks by executing input commands. The advantage that educational robotics especially (off- screen robotics) offers is that it engages children in hands- on- minds on approach, it is age appropriate and does not require electricity and thus compatible to Nigeria rural school environment. They are programmed to move, make noise, light up, and follow instructions as directed. Sullivan and Bers (2015), emphasizes that educational robotics is designed to make learners to advance their ability to think, design and build robots that perform a variety of task in a developmentally appropriate way. This innovation has provided opportunity for play -based hands-on learning of technology and engineering to young children in a developmentally appropriate way. Despite the advantage that educational robotics seems to provide, most of them requires electricity to operate. Hence the need for an off-screen approach.

Off-screen Robotics education such as KIBO robotics facilitates playful experiences while learning basic engineering concepts, such as programming skills, electronics, gearing and gear ratios, relative speed, direction of turning gears, torque and acceleration, loops, forks, subroutines, logic, the use of light/ultrasonic/infrared sensors, buoyancy, propulsion, balance, laws of motion, and physical processes (Elkin, et al 2016). If utilized in early childhood school setting, educational robots can enhance children's computational thinking, problem-solving, creative thinking, and a healthy sense of competition that drives innovation by learners hence, learners need to be expose to robotics through the off-screen option where there is no electricity and computers. Another reason why the off-screen educational robotics is important is because it is an interesting way to bring STEM to life for young children. This is because it encourages experimentation, teamwork, problem-solving and knowledge application and tech use in the simplest possible form (Khodabandeh, 2022).

Recently, there has been significant growth in interest and acquisition of technology related skills a critical demand of the twenty-first century work environments. Consequently, children have become technologically engaged daily in areas such as gaming, play toys, phones, laptops and computers, television, and videos at home and outside the home (Khodabandeh, 2022). Cirfat *et al.*, (2022) posits that commonly used digital technologies in early childhood programme include computers, educational robots, mobile devices like smart phones and tablets, smart boards, the internet, cameras, iPhones, iPads, digital cameras and many types of assistive technology. These devices have been progressively applied in early childhood classroom learning in developed nations such as USA and Europe. As observed by National Commission for Colleges of Education (NCCE, 2020) if Nigerian children must catch up with the increasing roles of digital technologies required in this fourth industrial revolution which is significantly becoming part of culture of the home, school, and in their immediate environment, digital learning should be made an integral part of learning in the early childhood Science Technology Engineering and Mathematics (STEM) curriculum and teacher training programmes.

Educational robotics and coding are among the 21st century innovations and skills being sort after globally by educational institutions and industry. Unfortunately Nigeria seems to lack behind both in teacher preparation and curriculum design that incorporates future oriented innovations such as coding, machine learning and Educational robotics as topics to be taught (Katniyon, et al. 2023). Also, local production of play based off-screen robots has not been prioritised as part of the early childhood STEM curriculum (Fabiyi *et al.,* 2016). Research reports about deployment of Play- based educational robotics curriculum and testing in early childhood STEM in Nigeria is not available. There is a need to design and test robotics curriculum appropriate to Nigerian pre service learners based on recent NCCE minimum standards. This study therefore sets out to design an educational robotics curriculum and test an off- Screen play- based educational robotics and curriculum for early childhood STEM pre- service teachers.

Problem Statement

Despite this progress and growing relevance of digital revolution in education especially at the early childhood level, Research in Nigeria Cirfat et al (2022); Katniyon et al. (2023) shows a gap exist in the

robot design skills for teacher preparation programmes and pre - school curriculum. This situation has Led to absence of indigenous tangible hands on robots materials for incorporation for use in play – based STEM learning and its curriculum in early childhood level. Off-screen educational robotics has been used effectively for early childhood STEM in USA and UK. It has been found to engage children in development of 21st century skills, it is also age appropriate and does not require electricity and thus compatible to Nigeria rural school environment (Bers 2015; Elkin 2016). Nigeria seems to be lagging behind in this technology and curriculum. This situation is worrisome and needs urgent attention. It is at the backdrop of this that this research intends to design and test an off- screen play based educational Robotics and curriculum for early childhood STEM Learning.

Theoretical Framework

Two theories guiding this research are constructivism and constructionism. Constructionism as an educational theory is student-centered and emphasizes discovery learning, where students are encouraged to work with tangible objects in the real world and use what they already know to gain more knowledge. Constructivism Theory states that knowledge constructed by connecting new experience to existing ideas. This aptly applies to the design of educational robots and curriculum using tangible technology to create new knowledge. The implication of this theory to the current study is that children will be provided with robotics education using the STEM curriculum as a spring board for acquiring skills required for effective 21st century world of work.

Objectives

The purpose of this research is to Explore the design and testing of an off - screen Educational Robotics curriculum among early Childhood STEM teachers in Plateau State. Specifically it intends to:

1. Find out if pre - service teachers' are able to identify robots components?
2. Assess if participants are able to demonstrate competence in robots design skills
3. Assess if teachers designed robots are effective when exposed to functionality test?

Research Questions

The following research questions will guide the study:

1. To what extent are participants able to demonstrate competence in robots design skills?
2. To what extent are pre - service teachers' able to identify robots components?
3. To what extent are the designed robots functional when exposed to functionality test?

Methodology

The research design is experimental design which intended to design and test Educational Robotics (ER) curriculum for pre-service teachers. The population will consist of NCE one students in the department of early childhood offering the course Science Technology Engineering and Mathematics STEM (ECE 124) in the 2023/2024 session. A Sample of 60 Pre service NCE teachers were selected. The school was selected as a research site in order to see how the robotics curriculum would unfold in a typical Nigerian public school, outside of a research lab setting. The course and level was selected to empirically observe how the new component STEM in the NCCE minimum standards for early childhood will be implemented by would be teachers. Also, it will provide an opportunity for pre- service teachers to be proficient in teaching 21st century engineering and technology aspects of STEM compared to peers in UK, Crete and USA.

The study lasted for 4-week with each week having an activity. Data was collected from the participants using two assessments instruments: the Robot Parts test (which will assess robotics knowledge) and secondly the Solve-Its tasks (which will assess design process). Robotics knowledge Test will assess pre-service teachers' knowledge of the use of educational robotics. The activities lasted for 4 weeks. Data was analysed using percentages, mean and Standard Deviation.

Curriculum Design Procedure

The educational robotics curriculum was implemented over the course of 4 weeks, four sets of pre-service teachers completed an introductory robotics curriculum taught by trained research assistants from the Departments of Early childhood, Technology and Computer of Federal

College of Education, Pankshin. Participants were evaluated using two instruments: Robots parts task and Solve -it Task

Off- screen Educational Robotics Curriculum

The robotics lessons were integrated with as part of the NCCE (2020) minimum standard for the course in early childhood education called Science Technology Engineering and Mathematics (STEM) course (ECE 124 and 212) were pre-service teachers explore the robotics component of each lesson involving a hands-on building or programming task that were completed in groups lasting 4 weeks. Each lesson was built on the concepts taught from the previous week, leading up to a culminating project with an interactive robot map representing the community. In the following sections, more details will be provided regarding the curriculum.

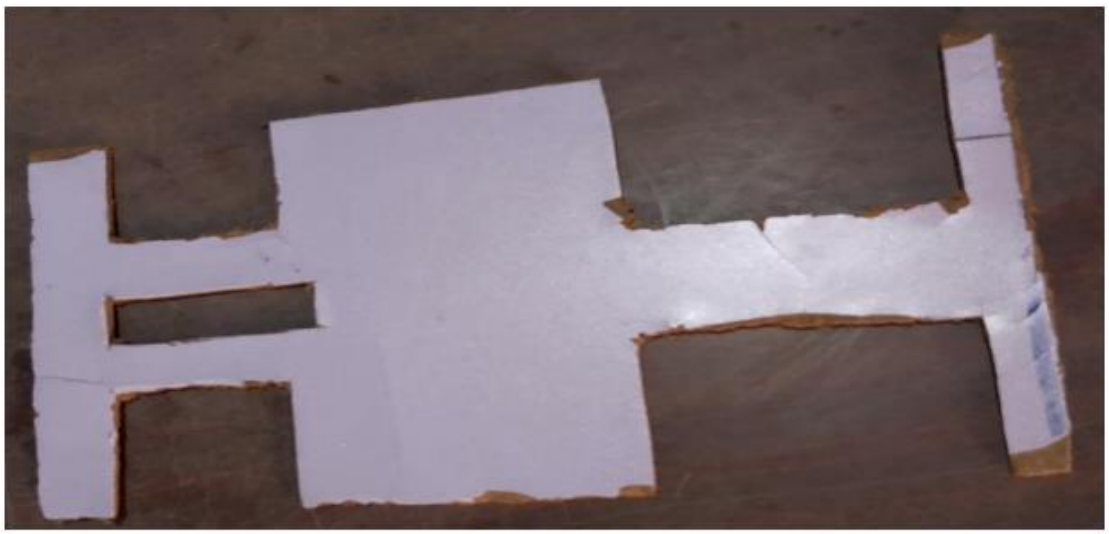
Week One: Introduction to Robots Parts

Participants were introduced to the following robots parts and their uses:

DC motors, Lithium ion battery, jumpers wire, plastic bottle, covers, 4mm electric conductors, carton paper , super LGC Gum glue, Popsicles sticks, half inch ply wood, razor blade, colour tape, aluminum sheet, shoe sawing trade, a mathematic set, a lighter, saw blade, rubber rings, empty biro straw, binding wire.

Activity 1:

Half-inch ply wood is cut in specific dimensions as show in Figure 1 using a hack saw blade which form our robotic chassis or base.



Figureure 1: Robot Chassis

Activity two:

Participants undertook the following activity: 4mm electric conductor is cut at 2cm in pairs to be used on the base rollers or tyres on left and right turn directions.

Figureure 2: Poles for front control motor

i. The empty biro straw (i.e the outer pipe) is also measured at 2cm and cut also in pairs, then the pipe is cut vertical at about 1.5cm to create an opening as shown in Figure 1;

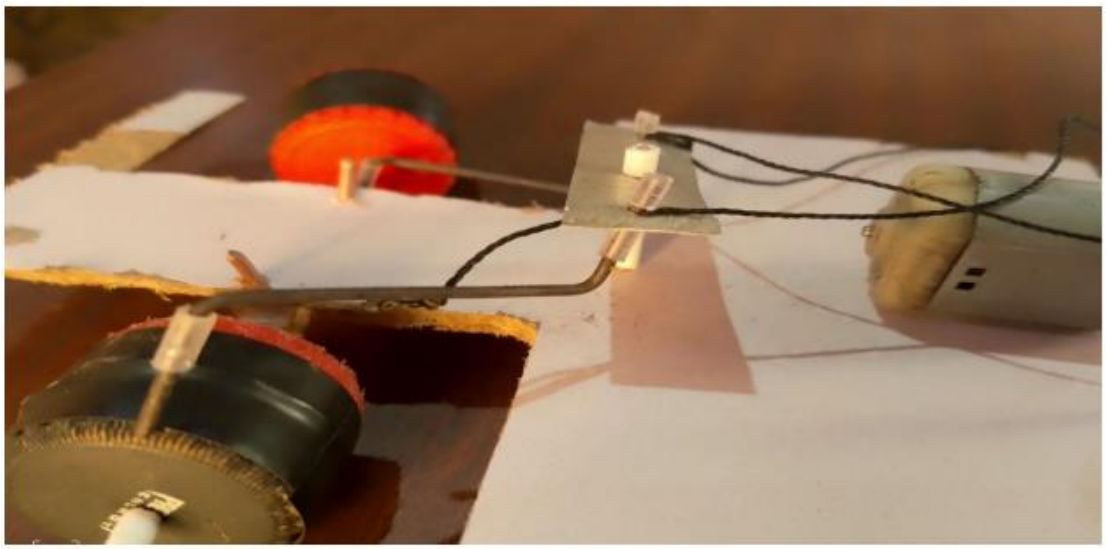
Figureure 3: Biro and Popsicle sticks straws

ii. Popsicle straw is also measure 2cm and cut in pairs to serve as opening connecting the controlling unit (steering system of the left and right direction motor of our robot chassis.

Figureure 4: Houses for front balancing control

Week Two: Robots part Design

The following curriculum activity was done: A hole was also bored on the Popsicle straw as was done in iii above to accept a pivot in which the front steering system is balanced with the help of an aluminum sheet of 6cm attached to 4mm conductor cut at 4cm balancing the aluminum sheet at the middle with Popsicle straws shielding the conductor as shown in Figure 3:

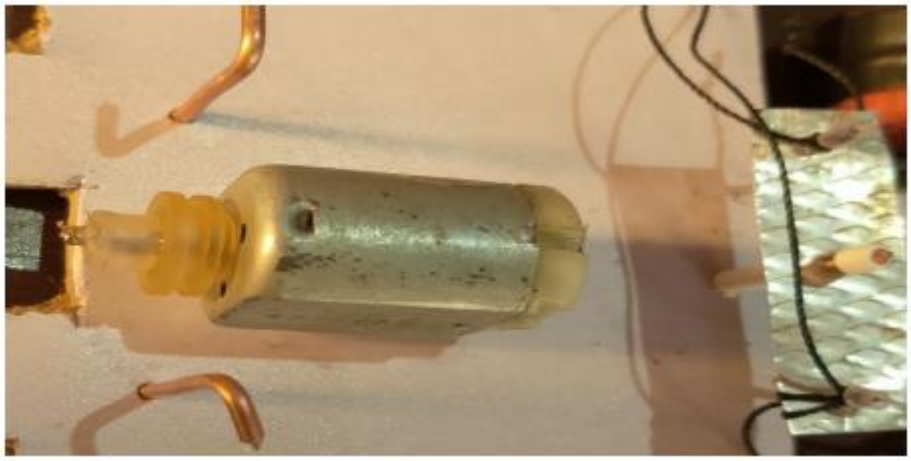


Figureure 5: Front wheel left and right balance

6cmm should be measured from pivoting pole backward and 2cm horizontally (i.e from left to right to mount two 3.5cm of 4mm pole ben at .5cm as shown in Figure 5;

Figureure 6: Aluminum Sheet for front balance

i. A DC motor should be mounted 6cm from the pivot pole and 1cm from above mounted poles in the middle with rotating shaft of the motor aligning to the two poles

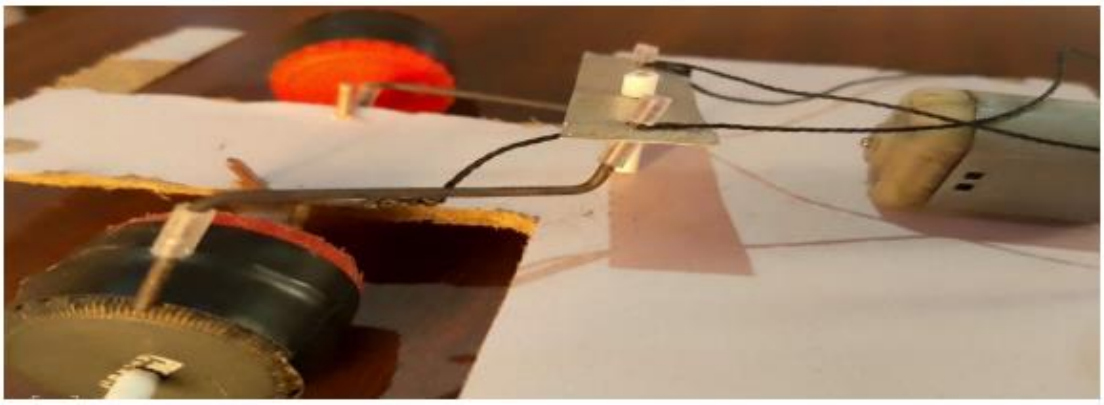


Figureure 7: Front wheel motor with poles

ii. A binding wire of 7.5cm should be cut and ben 1.5cm from one side and 2cm from the opposite side.

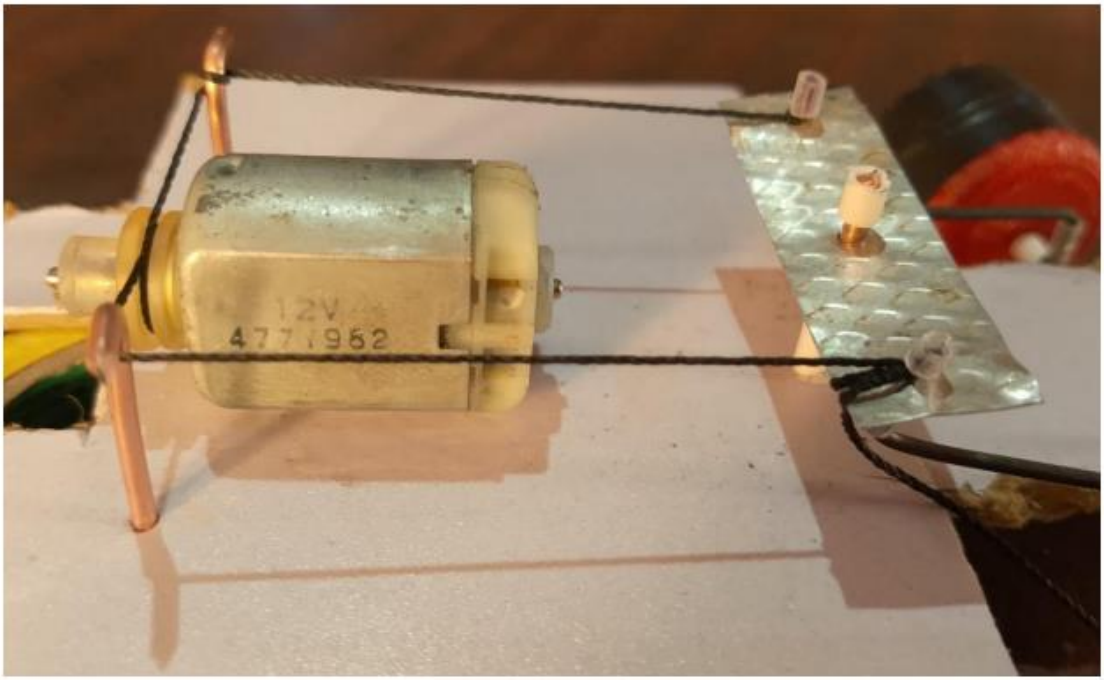
Figureure 8: Front wheel control rods

iii. The bended 1.5cm side should be connected through an empty biro (inner straw) through the loli pop straw connecting the rollers (tyres) at the front steering system



Figureure 8: Front wheel control sections connected to rollers

iv. A shoe sawing trade of about 17cm should be measured and cut out, this should pass through the aluminium sides .5cm from the edge where the binding wire is connected to the steering system from one side turning on the standing pivot pole through the DC motor shaft twisted to the other pole and back to the other edge of the aluminium sheets on the poles to serve as network facilitated the left and right turn of the robotic chassis.



Figureure 9: Front wheel complete control unit

Week Three: Robots Tyres Design

Two bottle covers of equal diameter should be tape using the coloured tape to form the rollers (tyres) and should be replicated to have four, such that two will be used at the front and two at the back to facilitate rolling or movement of out robot as shown in Figure 10;

Figureure 10: Rollers and tyres

i. Front wheels (tyres) are to be made from the two sealed bottle covers with 4mm conductor passing in the middle and terminated with a popsicle sticks at the outside such that the 4mm conductor wire is gum through the popsicle sticks that is connected at the front rollers (tyres)

ii. A carton of 1cm, .5cm diameter should be cut and duplicated each, then using a small hot gum wax to make gears to aid the movement of the rear rollers (tyres) connecting the big and small gears, such that the big is connected to the other DC motor then back to the small one passing through the rear rod made of broom stick and shielded with popsicle stick through an opening made 4.5cm from the pivot poles with a rubber ring as shown in Figure 11;

Figureure 11: Gear system parts

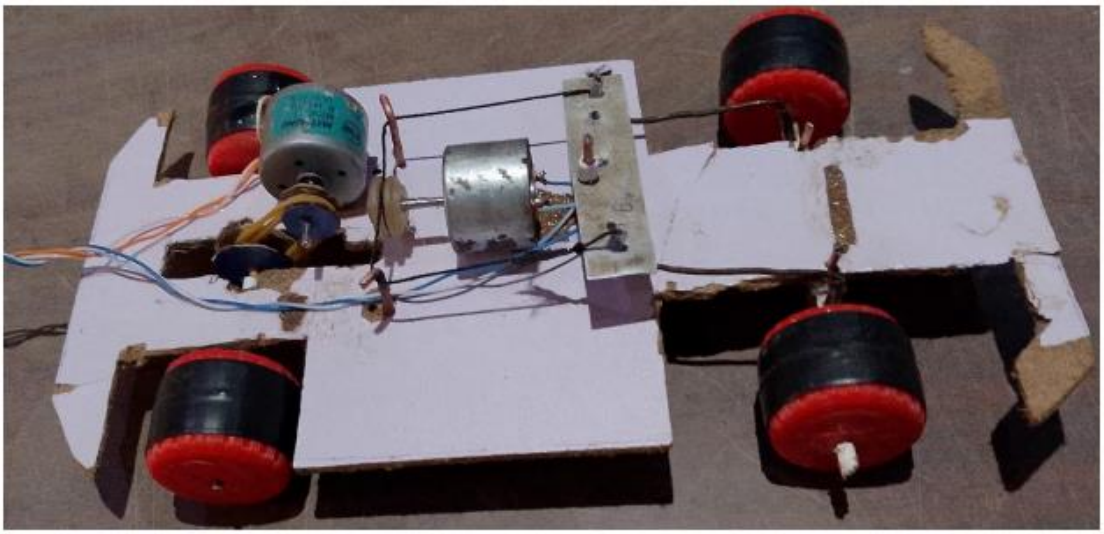
Week Four: Robots coupling Activities

The final aspects of the robots curriculum saw participants use of:

vii. Jumpers wire from rj45 cable from the DC motor terminals one negative and the other positive extended to a panel for controlling of the whole system mounted on a half-inch ply wood 13x8cm as shown in Figure 6; in order control left and right turned, forward and reverse movement of the front and rear rollers (tyres) of the entire robot platform

Figureure: 12: Jumper wires

The final coupling and testing of robot function test was done at the fourth week. Picture is seen in Figureure 13.



Figureure 13: Completed off screen robot

Figureure 13 presents the completed design of the robot car after the 4 weeks

Results

Findings from the study is presented based on the research questions as follows:

Research Question one:

To what extent are pre - service teachers' able to identify robots components?

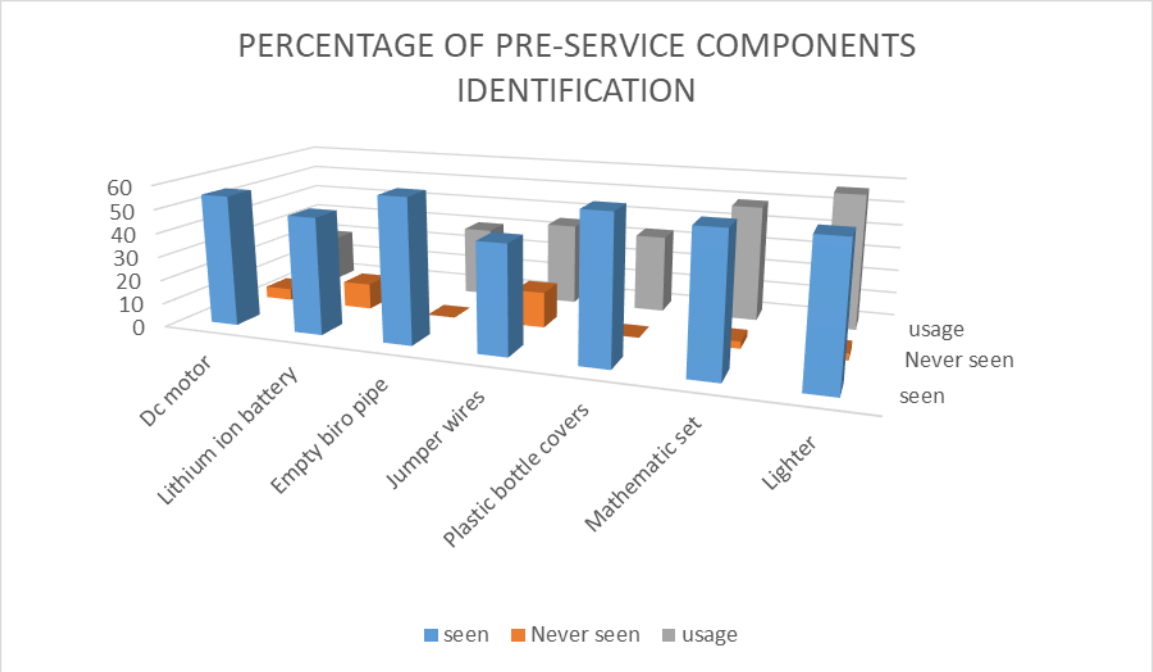
Table 1: Percentage of Component Identification by Participants

S/N	Components	Robot parts Identification			
		Low	percentage	High	Percentage
1	DC motor	55	91.66	5	8.34
2	Lithium ion battery	49	81.66	11	18.34
3	Empty biro pipe	40	66.66	0	33.34
4	Jumper wires	45	75	15	25
5	Plastic bottle covers	4	6.67	56	93.33
6	Mathematic set	50	83.33	10	16.67
7	Lighter	56	93.33	4	6.67

Source: Pre-testing exercise 2024

Data on Table 1 shows item being presented for identification include DC motors, Lithium ion battery, jumpers wire, plastic bottle, covers, 4mm electric conductors, carton paper , super LGC Gum glue, popsicle sticks, half inch ply wood, razor blade, colour tape, aluminum sheet, shoe sawing trade, a mathematic set, a lighter, saw blade, rubber rings, empty biro straw, and binding wire.

Table 1: Component Identification Survey



Figureure 14: Source: Pre-test exercise 2024

From data on table 1 and Figureure 50% of our participants did greatly in identification, 10% had never seen some of the components and a 55% has ever use the components in this project exercise. The fact that they have now seen, used it in this project exercise is an evidence that whatever they have seen, handle could be excellently use to achieve other projects of like manners less stressfully, also as they conceived an idea they can execute such without much issue. This implies that pre-service teachers are novice to robot part and use. This is agreement with findings of Cirfat et al (2022) and Katniyon et

al (2023) who found teachers to possess poor digital skills including robot parts. This position is worrisome, if the educational and societal benefits of robots design and use is to be effective in Nigeria and globally, then teachers must be availed opportunities to interact with and design robots parts which will positively influence their classroom practices in STEM teaching and learning.

Research Question Two:

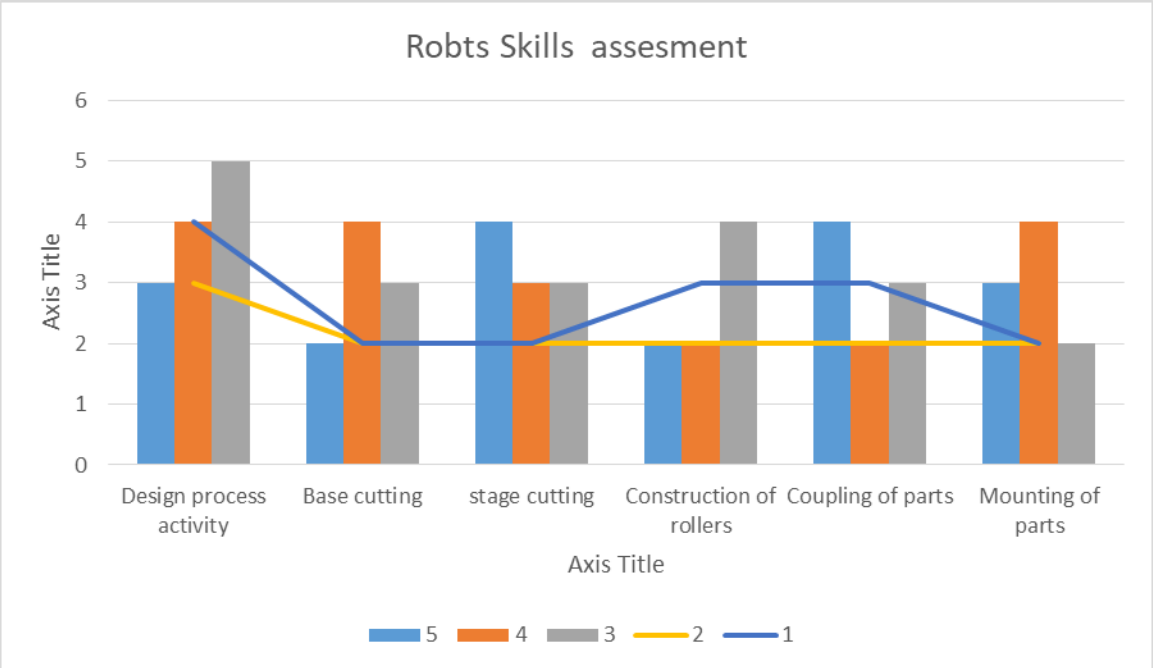
To what extent are participants able to demonstrate competence in robots design skills?

Table 2: Mean Robot Design Skills competence exhibited by participants

	Robots design skills being assessed	**N**	**X**	**SD**	**Decision**
1	Robots design process activities	60	3.6	0.80	VC
2	Robot base cutting	60	3.1	0.92	VC
3	Robots stage cutting	60	3.0	0.84	C
4	Construction of robots rollers	60	2.8	0.64	C
5	Coupling of robots parts	60	2.7	0.82	FC
6	Fixing of robots parts	60	3.2	0.66	C

Source: Pre-test exercise 2024

KEY: VC Very Competent, C =Competent, FC= fairly competent, NC Not competent



Figureure 15: Bar Chart of Robot skills test

Data on Table 2 shows the performance of participants had a very high competence in design process activities mean of 3.6, SD 0.80. While coupling of robots parts had the lowest competence mean of 2.7 SD 0.82. This implies that participants were effective in 90% of the

task assigned to them. Data on Table 2 shows that participants were very competent in robot design process activities and robot base cutting. The also showed competence in Robot stage cutting, construction of rollers and fixing of robot parts. They however showed only fair competence in coupling of robots parts. This in consonant with findings of Katniyon et al (2023) who discovered that teachers exposed to robots design training pick up interest and improved with practice. If Nigeria must be part of the 4 and 5th industrial revolution globally, then its teacher's must be deliberately exposed to 21st century pedagogical methodologies such as robot designs to impart these skills on the children they teach especially at the foundational school levels. Early design skills are capable of laying adequate foundation for future careers in STEM areas.

Research Question Three

To what extent are the designed robots functional when exposed to functionality test?

Table 3: Mean functionality test exhibited by designed robots

	Robots design skills being Assessed	**Functionality**				
		N	**Low**	**Average**	**High**	**Decision**
1	Completeness of form	60		X		Functional
2	Age appropriate	60			X	Functional
3	Ease of use	60		X		Functional
4	Motion and functioning	60		X		Functional
5	Compliance with safety	60	X			Needs improvement
6	Durability	60		X		Functional
7	Educational value	60			X	Functional

Source: Pre-test exercise 2024

Data on table 3 indicate that the designed robots have high educational value and are age appropriate. The robots are averagely complete in form, ease of use motion and durability. The designs however have low compliance to safety. This implies an average functionality test for the design off screen robots. Functionality test of any engineering equipment is very important if it must not be an excise in futility. Interest and attitude towards a design process increases if there is a functional display of the usability of the product from participants (Eguchi, 2016; Katniyon et al 2023). In a classroom setting the teacher's confidence to improve the technology and engineering component of STEM engagements is enhanced in areas of age appropriateness ease of use safety compliance and educational

values amongst others. Ultimately enhancing learner's creativity, critical thing and problem solving skills.

Conclusion

In our growing technological world today, exposing teachers to education robotic curriculum is highly encouraged as it boost teacher's confidence to improve their 21st technology and engineering skills component of STEM. This improves teacher competence, preparation in areas of technology and engineering, age appropriateness of instructional materials ease of use safety compliance and educational values amongst others. Ultimately developing learner's creativity, critical thing and problem solving skills for viable products design and patent acquisition.

Recommendation

The problem of neglect of the T and E aspects of Science Technology and Engineering (STEM) at the early childhood levels of education in Nigeria due to teachers 'low capacity to engage lower level learners with the engineering and technology aspects of the STEM curriculum can be addressed by engaging the following:

i. Teacher training institutions should organise workshops and training on design of an off-screen, play based educational robotic curriculum should be implemented in order to allow early exposure to STEM.

ii. Universities and Colleges of education should be a design educational robotics curriculum and tools for early childhood robotics.

iii. Teacher training colleges should organised in-service training to improve teacher competent in handling engineering and technology parts and programming of STEM robots.

Acknowledgement

Researchers acknowledge the funding support from Tertiary Education Trust fund for this Research

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Rima International Journal of Education (RIJE), Vol. 3 (No. 3): Nov 2024; page: 18-33 ISSN: 2756 - 6749

Recycling of Plastic Waste Products through Innovative Design Approach in Teaching and Learning of Basic Science and Technology in Pankshin Local Government Area

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Abstract

The study was carried out to investigate the recycling of plastic waste products through innovative design approach in teaching and learning Basic Science and technology in Pankshin Local Government Area of Plateau State. The population for the study was 11,600. 372 students were used as sample size. The instrument used for data collection was a questionnaire. Descriptive statistics of percentage and mean scores was used as method of data analysis. The result obtained from the study showed that plastic waste management practices in Pankshin are generally accepted, effective, and aware, but challenges exist, and collaboration needs enhancement. Integrating plastic waste recycling into basic science is widely accepted, teachers are equipped, curriculum flexibility exists, but hands-on activities need improvement. The innovative design approach improves students' comprehension, raises awareness and influences attitudes positively, but hands-on experiences and connections need improvement. Recommendations for sustainable practices in basic science are accepted but suggest improvements in guidelines, professional development, resource allocation, and collaboration. It was recommended that curriculum developers should create comprehensive guidelines for teachers, accompanied by professional development programs. This ensures educators are weli-equ4iped and trained to seamlessly integrate innovative design approaches into basic science lessons.

Key Words: Recycling, Plastic Waste Products, Innovative Design Approach, Teaching, Learning Basic Science and Technology

Introduction

Learning Basic Science and Technology in junior secondary schools in Nigeria is essential for equipping students with foundational knowledge and skills necessary for scientific and technological literacy. The subject not only enhances students' understanding of core scientific concepts but also fosters critical thinking, problem-solving, and innovation, which are crucial for national development in an increasingly tech-driven world (Ogunleye & Adeyemo, 2019). Basic Science and Technology plays a crucial role in educating students about environmental issues and sustainable practices, particularly in the context of waste management and combating environmental

degradation. By integrating topics on ecology, pollution, and resource conservation, Basic Science and Technology curricula raises awareness among learners, about the adverse effects of improper waste disposal and the importance of sustainable practices. Studies have shown that teaching Basic Science and Technology with a focus on environmental science enables students to understand the impact of waste on ecosystems and encourages them to adopt practices such as recycling, in ensuring waste reduction (Eze, 2019).

The growing concern over environmental degradation and plastic pollution has led to an increased emphasis on sustainable practices and education. Plastic waste, a significant contributor to environmental degradation, poses threats to ecosystems, wildlife, and human health. As a response to the fore-going issues, researchers and educators have been exploring innovative approaches to tackle both the issue of plastic waste and the need for effective science education. Integrating recycling of plastic waste products through an innovative design approach into the teaching and learning of Basic Science and Technology emerges as a promising avenue.

Plastic waste pollution has become a pressing environmental concern globally including Nigeria. The improper disposal of plastic waste leads to detrimental effects on the environment posing a risk to human health, and contributing to the degradation of natural ecosystems (Ezebilo, 2019). In particular, Pankshin Local Government Area of Plateau State has witnessed a rise in plastic waste accumulation, leading to significant challenges in waste management and environmental preservation (Plateau Environmental Protection and Sanitation Agency, 2020). At the same time, there is an ongoing need to enhance the quality of Basic Science and Technology education in Nigerian schools. A lack of effective teaching and appropriate educational materials can hinder students' understanding in science subjects (Akinyemi, 2016). Plastic pollution has gained international attention due to its adverse impact on ecosystems and the environment. The presence of plastics in the environment, coupled with improper disposal practices, has led to pollution of land, water bodies, and air (Barnes, Galgani, Thompson & Barlaz, 2009). The detrimental effects of plastic pollution necessitate urgent action, not only in waste management but also in educating future generations about responsible consumption, environmental health and waste reduction.

The concept of an innovative design approach in recycling plastic waste products have gained increasing attention as environmental concerns about plastic pollution continue to grow. This approach involves rethinking and redesigning how plastic waste is collected, processed, and repurposed, aiming to reduce waste while creating functional, aesthetically pleasing products. Innovative design approaches integrate sustainability at every stage of the recycling process, from sourcing raw plastic waste to transforming it into reusable materials. For instance, "upcycling" methods turn discarded plastics into high-value items, such as construction materials or durable consumer products, rather than downcycling them into lower-grade materials. Studies highlight that reimagining plastic recycling through design innovation helps address waste issues while promoting circular economy principles (Wang et al., 2018).

Moreover, recent technological advancements have introduced methods to enhance the quality and versatility of recycled plastic products. For example, researchers have developed advanced sorting systems and chemical recycling processes that break down plastics at a molecular level, making them easier to reform into new products without compromising quality (Hopewell et al., 2020). These methods not only improve the efficiency of recycling but also expand the types of products that recycled plastics can become, allowing for a broader range of applications in various industries.

In recent years, educational paradigms have shifted towards experiential and problem-based learning, aimed at engaging students in real-world issues (Dewey, 2018; Koib, 2020). This study builds upon this trend by proposing an innovative design approach that incorporates recycling of plastic waste products as a central theme in the teaching and learning of Basic Science. Such an approach aligns with the principles of contextual and constructivist learning, where students are encouraged to explore, inquire, and apply their learning to real-life scenarios (Piaget, 1970).

The integration of recycling plastic waste products as an educational tool not only addresses environmental concerns but also offers a multidisciplinary learning experience. It promotes critical thinking and problem-solving skills as students explore the science behind plastic composition, degradation, and recycling processes (Jacobson & Wilensky, 2006). Furthermore, it fosters a sense of environmental responsibility and citizenship, empowering students to become active

contributors to sustainability efforts in their communities (Hungerford & Volk, 1990).

By examining the implementation of this innovative approach in the context of Basic Science and Technology education.This study is aimedat contributing valuable insights into the effectiveness of combining environmental awareness with science learning. It assessed the impact on students, understanding of scientific concepts, their attitudes towards recycling, and the overall effectiveness of such an approach in enhancing engagement and learning outcomes.

Problem Statement

The rapid accumulation of plastic waste has become a major environmental concern globally, and the situation is not different in Pankshin Local Government Area of Plateau State, Nigeria. Plastics, being non-biodegradable, pose significant challenges to waste management and contribute to environmental pollution. Studies have highlighted that the improper disposal of plastic waste leads to environmental degradation, health hazards, and the depletion of natural resources (Geyer, Jambeck, & Law, 2017). In the context of education, integrating environmental issues, such as, plastic waste recycling into the curriculum is crucial in raising awareness and promoting sustainable practices. However, limited attention has been given to the role of recycling plastic waste in the teaching and learning of Basic Science and Technology in secondary schools, which could provide innovative solutions to this growing problem.

The use of innovative design approaches, such as the recycling of plastic waste into teaching aids and instructional materials, presents a unique opportunity to enhance science education. The creative reuse of plastic waste can help to contextualize scientific concepts while promoting environmental stewardship among students. According to recent studies, hands-on activities that involve the practical application of scientific principles through recycled materials can improve students' engagement and understanding of scientific concepts (Shahnawaz, Sangale & Ade, 2019 and Akinyemi & Apanisile, 2020). Despite the potential benefits, many schools in Pankshin Local Government Area of Plateau State lack the necessary frameworks and resources to effectively incorporate recycling as an educational tool, leaving a gap in environmental education and innovative teaching methods. Furthermore, there is a lack of empirical research that explores the impact of recycling plastic waste products on students' academic performance and interest in Basic Science.

Educational systems have not fully leveraged the potential of recycled materials to foster creativity, critical thinking, and problem-solving skills in science learning (Salau, 2019). This study, therefore, investigated how the recycling of plastic waste through innovative design approaches could be used to enhance the teaching and learning of Basic Science and Technology in secondary schools in Pankshin Local Government Area, contributing to both environmental sustainability and improved educational outcomes.

Objectives of the Study

The main aim of this study is to find out the recycling of plastic waste products through innovative design approach in teaching and learning Basic Science in Pankshin Local Government Area. Specifically, the study seeks:

1. To investigate the current state of plastic waste management in Pankshin Local Government Area and identify challenges associated with its disposal.
2. To explore the effectiveness of an innovative design approach that incorporates recycling plastic waste products into the teaching and learning of Basic Science.
3. To assess the impact of innovative approach on students' understanding of basic science concepts, environmental awareness, and problem-solving skills.
4. To provide recommendations for integrating sustainable practices, such as recycling, into the educational curriculum to foster environmentally conscious citizens.

Research Questions

The following research questions guided the study:

1. What is the existing scenario of plastic waste management in Pankshin Local Government Area, including challenges and current disposal practices?
2. How can an innovative design approach for recycling plastic waste products be integrated into the teaching and learning of basic science?
3. What is the impact of the innovative design approach on students' comprehension of Basic Science and Technology concepts?

4. What recommendations can be made to educational policymakers and curriculum developers to promote the incorporation of sustainable practices into the basic science curriculum?

Methodology

The research employed a survey research design. As described by Mwanse, Dalong, Kasai, and Zuhumben (2016), survey research design is the method used to gather the opinions, attitudes, and interests of a population through a carefully chosen representative sample. This approach ensures that data are collected from respondents whose views accurately represent the entire population. The study used both public and private secondary schools in Pankshin Local Government Area of Plateau State, totaling 27 public and 42 private schools. The estimated student population in this area was 11,600 (Area Directorate Office Pankshin, 2023).

Simple random sampling technique was utilized to choose ten schools, comprising five private and five public schools. Out of these ten selected schools, a sample size of 372 students was selected. The sample is considered adequate base on the Krejcie and Morgan (1970) table for sample size determination. The selected schools are shown in table 1:

Table 1: Distribution of Sample Size

S/N	Name of Schools	School Type	Sample
1	Government Secondary School, Bet Pankshin	Government	46
2	Government Model Secondary School, Pankshin	Government	53
3	Government Secondary School, Chigong	Government	31
4	Government College Pankshin	Government	42
5	Government Secondary School, Fier	Government	28
6	Saint Benedict Minor Seminary Pankshin	Private	49
7	Good Shepherds College Pankshin	Private	25
8	Solid Foundation Academy Pankshin	Private	27
9	Langkuk Comprehensive Memorial Secondary School Pankshin	Private	48
10	Trinity Missionary College Pankshin	Private	23
	TOTAL		372

The study employed the simple random sampling technique to select a total of 372 studs from the 10 sampled secondary schools, encompassing both public and private institutions. The process involved randomly choosing the students from a combined pool of 27 public schools am 42 private schools in Pankshin Local Government Area of Plateau State. To accomplish this, the 27 public schools were

written on small pieces of paper, placed in a container, and randomly drawn. Similarly, the 42 private secondary schools were mixed together, and five private schools and five public schools were randomly selected. The researcher then visited the chosen schools to collect data from twenty students in each school, resulting in a total of 372 students across the selected schools.

A structured questionnaire, for the students on "Recycling Plastic Waste Products Questionnaire" (RPWPQ) was used for data collection based on the research problem. The questionnaire was designed based on the research problems. The questionnaire was made up of two sections; Sections A and B. Section A consisted of personal data of students such as sex, age, while Section B essentially consisted of recycling plastic waste products through innovative design approach in teaching and learning Basic science in Pankshin Local Government Area. The questionnaire consisted of a total of 20 items, which the respondents will provide answer to. The questionnaire was structured using the Likert five-point response scale. Likert scales also include a neutral midpoint, "neither agree nor disagree" for respondents that do not hold a positive or negative opinion on a particular topic. The instrument was subjected to content validity where the questionnaire constructed was subjected to judgment by test and measurement experts. After necessary corrections were made, the instruments were administered to the respondents. To establish the reliability of the instrument, two experts were given the instruments for rating in respect of the consistency with the research objectives. To establish the reliability of the instrument, the researcher used Cronbch alpha method to establish the internal consistency reliability of 0.87. The questionnaires were directly administered to the respondents by the researcher in their schools. Items/statements perceived to be difficult by the respondents were explicitly explained by the researcher. The direct administration approach was adopted to ensure a high collection rate of the questionnaires.

The data obtained from the questionnaires were analyzed using descriptive statistics of percentage, frequency and mean scores. A mean score of less than 3.0 is considered disagreed, while a mean score of 3.0 and above is considered agreed while a mean score below 3.0 is considered disagreed.

Results

Research Question One: What is the existing scenario of plastic waste management in Pankshin Local Government Area, including challenges and current disposal practices?

Table 2: Mean responses on the existing scenario of plastic waste management in Pankshin Local Government Area, including challenges and current disposal practices

S/N	Statement	Responses					Total	Mean	Decision
		SA (5)	A (4)	N (3)	D (2)	SD (1)			
1	The current plastic waste management practices in Pankshin LGA are effective in addressing environmental concerns	208	93	59	12	0	372	4.37	Accepted
2	Local authorities face challenges in implementing efficient plastic waste disposal methods.	144	180	22	13	13	372	4.15	Accepted
3	Public awareness regarding proper plastic waste disposal is high in Pankshin LGA	140	200	16	9	7	372	4.23	Accepted
4	The existing plastic waste management infrastructure in the area is sufficient handle the volume of generated waste	133	176	30	22	11	372	4.07	Accepted
5	There is a need for improved collaboration between local government and community members to address plastic waste challenges.	166	189	8	7	2	372	4.37	Accepted

Source: Field Survey, 2024

The mean responses from Table 2 indicate a generally positive perception of the existing scenario of plastic waste management in Pankshin Local Government Area. Firstly, respondents believe that current practices are effective in addressing environmental concerns, with a mean score of 4.37, suggesting a high level of satisfaction with the outcomes. However, despite this effectiveness, local authorities face challenges in implementing efficient disposal methods, as evidenced by the mean score of 4.15 for this statement. Despite the challenges, public awareness regarding proper plastic waste disposal

is perceived to be high, with a mean score of 4.23, indicating a strong foundation for community engagement in waste management efforts.

Furthermore, the existing plastic waste management infrastructure is deemed sufficient to handle the volume of waste, supported by a mean score of 4.07. However, there is room for improvement in collaboration between local government and community members to address plastic waste challenges, as indicated by a slightly lower mean score of 4.37 for this statement. Overall, while there are challenges to overcome, the existing scenario suggests a solid foundation for effective plastic waste management in the area.

Research Question Two: How can an innovative design approach that involves recycling plastic waste products be integrated into the teaching and learning of basic science?

Table 3: Mean responses on how can an innovative design approach that involves recycling plastic waste products be integrated into the teaching and learning of basic science.

S/N	Statement	Responses					Total	Mean	Decision
		SA (5)	A (4)	N (3)	D (2)	SD (1)			
1	Integrating recycling of plastic waste products into basic science lessons will enhance students' understanding of scientific concepts.	178	123	20	28	23	372	4.09	Accepted
2	Teachers are well-equipped and trained to incorporate innovative design approaches involving plastic waste recycling into the basic science curriculum.	181	133	08	25	25	372	4.13	Accepted
3	Students find hands-on activities related to recycling plastic waste engaging and beneficial for learning	129	199	24	13	7	372	4.16	Accepted
4	The current basic science curriculum provides sufficient flexibility for the integration of innovative design approaches.	146	159	30	20	17	372	4.07	Accepted
5	Integrating plastic	120	201	33	7	11	372	4.11	Accepted

	waste recycling basic science classes is a practical way to instill environmental consciousness among students.								

Source: Field Survey, 2024

Table 3 outlines mean responses on integrating an innovative design approach involving recycling plastic waste into the teaching and learning of basic science. The first statement suggests that integrating recycling into basic science enhances students' understanding, with a mean score of 4.09, indicating acceptance. The second statement implies that teachers are well-equipped for such integration, receiving a mean score of 4.13, suggesting acceptance. The third statement indicates that students find hands-on activities engaging, scoring 4.16, suggesting acceptance but with room for improvement. The fourth statement suggests that the current basic science curriculum allows for flexibility, receiving a mean score of 4.07, indicating acceptance. The fifth statement proposes that integrating plastic waste recycling instills environmental consciousness, with a mean score of 4.11, indicating acceptance.

Research Question Three: What is the impact of the innovative design approach on students' comprehension of basic science concepts and their awareness of environmental issues?

Table 4: Mean responses on impact of innovative design approach on students' comprehension of basic science concepts and their awareness of environmental issues

S/N	Statement	Responses					Total	Mean	Decision
		SA (5)	A (4)	N (3)	D (2)	SD (1)			
1	Students' comprehension of basic science concepts improves when exposed to the innovative design approach involving plastic waste recycling.	238	78	37	19	0	372	4.44	Accepted
2	The integration of plastic waste recycling activities raises students' awareness of environmental issues.	186	124	37	21	7	372	4.26	Accepted
3	Students believe that learning through hands-on experiences with plastic waste	111	112	112	26	11	372	3.78	Accepted

	recycling enhances their overall understanding of basic science.								
4	The innovative design approach positively influences students' attitudes towards sustainable practices.	186	74	37	56	19	372	3.95	Accepted
5	Students perceive a connection between basic science concepts and real-world environmental challenges through the recycling activities.	133	121	77	37	4	372	3.89	Accepted

Source: Field Survey, 2024

Data on table 4 shows that the first statement implies that students' comprehension improves with the innovative design approach, receiving a mean score of 4.44, indicating acceptance. The second statement suggests that integrating plastic waste recycling raises students' awareness of environmental issues, with a mean score of 4.26, indicating acceptance. The third statement indicates that students believe hands-on experiences enhance their understanding, scoring 3.78, signifying acceptance with room for improvement. The fourth statement implies a positive influence on students' attitudes towards sustainable practices receiving a mean score of 3.95, indicating acceptance. The fifth statement suggests that students perceive a connection between science concepts and environmental challenges, scoring 3.89 indicating acceptance.

Research Question Four: What recommendations can be made to educational policymakers and curriculum developers to promote the incorporation of sustainable practices into the basic science curriculum?

Table 5: Mean responses on recommendations to promote the incorporation of sustainable practices into the basic science curriculum

S/N	Statement	Responses SA (5)	A (4)	N (3)	D (2)	SD (1)	Total	Mean	Decision
1	Policymakers should prioritize the inclusion of sustainable practices, such as plastic waste recycling, in the basic science curriculum.	158	131	33	37	13	372	4.03	Accepted
2	Curriculum developers should create guidelines and resources for teachers to seamlessly integrate	107	212	18	20	15	372	3.96	Accepted

	innovative design approaches into basic science lessons.								
3	Professional development programs should be established for educators to enhance their skills in teaching BST through sustainable practices.	169	183	09	8	3	372	4.36	Accepted
4	Policymakers should allocate resources and support for schools to implement recycling initiatives within the basic science curriculum.	155	192	07	13	5	372	4.29	Accepted
5	Policy makers should collaborate with environmental experts to ensure that basic Science curriculum reflects current environmental challenges and solutions	195	167	4	9	0	372	4.50	Accepted

Source: Field Survey, 2024

Table 5 presents mean responses on recommendations for educational policymakers and curriculum developers to promote the incorporation of sustainable practices into the basic science curriculum. The first statement proposes prioritizing the inclusion of sustainable practices, scoring 4.03, indicating acceptance. The second statement suggests creating guidelines for teachers scoring 3.96, signifying acceptance with room for improvement. The third statement indicates the establishment of professional development programs, scoring 4.36, indicating acceptance with room for improvement. The fourth statement proposes allocating resources for schools to implement recycling initiatives, scoring 4.26, indicating acceptance. The fifth statement suggests collaboration with environmental experts, scoring 4.50, indicating acceptance. The aggregate average mean across all recommendations is 3.25, reflecting an overall acceptance of the proposed recommendations.

Discussion

The preceding section of this chapter presented the analysis of the data from the questionnaire based on the four research questions. The findings from Table 2 reveal a generally positive assessment of the existing scenario of plastic waste management in Pankshin Local Government Area. Respondents acknowledged the effectiveness of current plastic waste management practices in addressing environmental concerns. This aligns with the idea that efficient waste management is crucial for environmental sustainability (Kaza et al., 2018). However, the recognition of challenges faced by local

authorities in implementing efficient disposal methods highlights the need for strategic interventions and support to overcome these hurdles (Olawale & Sun, 2018). The high public awareness regarding proper plastic waste disposal is a promising aspect, emphasizing the potential for community involvement and support in waste management initiatives (Wilson et al., 2018).

Table 3 provides insights into the integration of an innovative design approach involving recycling plastic waste into basic science education. The positive perception that integrating recycling into basic science enhances students' understanding aligns with the growing emphasis on experiential and applied learning (Doppelt, 2003). Teachers being perceived as well-equipped for such integration are a positive finding, suggesting that the educational system is preparing educators for innovative teaching methods. The acknowledgment of students finding hands-on activities engaging underscores the potential of incorporating practical elements into the curriculum to enhance student interest and participation (Prince & Felder, 2006). The emphasis on the flexibility of the current basic science curriculum aligns with the call for adaptable and dynamic educational frameworks (Biesta & Tedder, 2007). Furthermore, the recognition that integrating plastic waste recycling instills environmental consciousness aligns with the broader goal of fostering sustainability education (Sterling, 2004).

The findings from Table 4 highlight the positive impact of the innovative design approach on students' comprehension of basic science concepts and their awareness of environmental issues. The acknowledgment that students' comprehension improves with the innovative design approach reinforces the notion that hands-on and practical learning can enhance academic performance (Hattie, 2009). The recognition that integrating plastic waste recycling activities raises students' awareness of environmental issues aligns with the potential of education to contribute to environmental literacy (Rickinsori et al., 2004). While students believe that hands-on experience enhances their understanding is positive, the acknowledgment of room for improvement suggests a need for continuous refinement of teaching strategies to maximize their effectiveness (Bell, 2010). The positive influence on students' attitudes towards sustainable practices is a promising outcome, reflecting the potential of education to shape pro-environmental behaviors (Koilmuss & Agyeman, 2002). Lastly, the recognition that students perceive a connection between science concepts and real-world

environmental challenges emphasizes the integrative potential of curriculum design (Wals & Jickling, 2002).

Table 5 provides recommendations for educational policymakers and curriculum developers to promote the incorporation of sustainable practices into the basic science curriculum- The proposal to prioritize the inclusion of sustainable practices aligns with the global movement towards sustainable development goals (UNESCO, 2017). The suggestion to create guidelines for teachers reflects the importance of providing educators with the necessary resources and frameworks to implement innovative teaching practices (Darling-Hammond et al., 2017). The call for professional development programs for educators underscores the continuous need for training and capacity-building to enhance teaching competencies (Ingersoll & Strong, 2011). The recommendation to allocate resources for schools to implement recycling initiatives emphasizes the practical support required at the institutional level (Wals, 2014). Lastly, the suggestion for policymakers to collaborate with environmental experts aligns with the interdisciplinary nature of addressing environmental challenges (Bowers, 2006).

Conclusion

In conclusion, the findings from the study shed light on the existing state of plastic waste management in Pankshin Local Government Area and the potential integration of an innovative design approach involving recycling in basic science education. The acceptance and effectiveness of current plastic waste management practices underscore the community's awareness of environmental concerns. However, challenges and the need for enhanced collaboration among stakeholders' highlight areas for improvement. Similarly, the positive reception of integrating plastic waste recycling in basic science, along with well-equipped teachers and a flexible curriculum, signals the potential for sustainable educational practices. Despite this, the study identified a need for refinement in hands-on activities, emphasizing the importance of continuous improvement in teaching methodologies. The impact of the innovative design approach on students' comprehension and awareness signifies its potential to enhance educational outcomes and instill environmental consciousness. The positive influence on students' attitudes towards sustainable practices aligns with the broader goal of fostering environmentally responsible citizcns. However, the identified room for

improvement in hands-on experiences suggests the necessity of refining the practical aspects of the implemented approach.

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Rima International Journal of Education (RIJE), Vol. 3 (No. 3): Nov 2024; page: 34-44 ISSN: 2756 - 6749

Dynamics of Parenting Styles as Correlate of Deviant Behaviour among the Adolescents in Senior Secondary Schools, Lagos State

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Abstract

The objective of this study is to investigate the dynamics of parenting styles as correlate of deviant behavior among adolescents in secondary schools in Lagos State. Three research hypotheses were designed for this work as survey research design type of correlational approach was used in this study. This design was considered appropriate because it allows the researcher to determine the relationship between parenting style and deviant behaviour among adolescents. Population comprised of over 24, 914 public senior secondary school students from twelve schools in Ojo Local Government Area of Lagos State. Simple random sampling technique was employed to select sixty (60) adolescents each from five selected schools as sample of the study. Deviant Behaviour Variety Scale (DBVS) and self-developed Parenting Styles and Adolescent Behaviour Questionnaire (PSABQ) used for data collection. Content and Construct validity were determined by academic from Lagos State University of Education, Epe, as reliability of the instruments was determined through split-half form, and reliability index of 0.894 and 0.882 was obtained meaning suitable for this study. Data was analysed through Pearson Product Moment Correlation (PPMC) analysis and tested at significant level of 0.05 respectively. The study revealed that parenting styles (authoritarian, authoritative and permissive) correlated with deviant behaviours of adolescents. It then concluded that parents should apply some form of direction, caution and guidance because it goes a long way to preventing them from engaging in deviant behaviours.

Key Words: Adolescents, Parenting Styles, Deviant Behaviour, Students, Emotional

Introduction

Parenting is the process of promoting and supporting the physical, emotional and intellectual development of a child from infancy to adulthood. It entails adopting the skill of molding, shaping, guiding and inculcation of morals and support towards the development of an individual from infancy stage to adulthood (Roubinov & Boyce, 2017). Parenting provides children with opportunities of acquiring skills and experiences necessary for the achievement of goals in adulthood. It plays a key role in the overall development of the child. Such roles are

social, educational and other adaptive behaviours that prepare a child for future fruitful living. Parents are the first educators of their children and they are responsible for providing them with physical, emotional and mental framework for learning. Individual parents therefore, carry out the function of parenting differently, because of differences in personalities and exposures thereby giving rise to different parenting styles. Parenting style refers to the broad overall pattern of parental actions. Parenting style is how a person or a parent interacts with his/her children or wards and the different patterns that parents use to bring up their children or wards. In this work, the patterns identified include authoritarian, authoritative and permissive styles.

For authoritarian parenting style, Angel, (2016) see it as an extremely strict parenting style. It places high expectation on children with little responsiveness. Parents expect kids to follow the rules with no discussion or compromising. Authoritarian parents are famous for saying, because I said so when a child questions the reasons behind a rule (Ang & Groh, 2016). They are not interested in negotiating and their focus is on obedience. They also do not allow kids to get involved in problem-solving challenges or obstacles. Instead, they make the rules and enforce the consequences with little regard for the child‘s opinion. Authoritarian parents may use punishments instead of discipline. Children who grew up with strict authoritarian parents may tend to follow rules most of the time. Children of authoritarian parents are at a higher risk of developing self-esteem problems because they believed that their opinions are not valued. Children of authoritarian parents tend to have an unhappy disposition, less independent, appear insecure, possess lower self-esteem, exhibit more behavioural problems, have poorer social skills and are more likely prone to mental issues. They may also become hostile or aggressive (Eke, 2014). Rather than think about how to do things better in the future, they often focus on the anger they feel toward their parents. Since authoritarian parents are often strict, their children may grow to become good liars in an effort to avoid punishment (Ang & Groh 2016).

However, the authoritative parenting style also known as democratic style, see parent as one that nurtures, responsive, and supportive, yet set firm limits for their Children. They attempt to control children’s behaviour by explaining rules, discussing and reasoning (Aute, 2019). Authoritative parents create a loving home environment and provide a high degree of emotional support. Parents using this are firm,

consistent and fair. The parents establish and enforce behaviour standards and stay in control by encouraging their children to follow the norms of the society. Parents use reason, negotiation and persuasion, not force, to gain their children's cooperation. According to Ortese, (2008), their listening-demanding ratio is roughly equal. In authoritative parenting, children's opinions are valued and respected. They are encouraged to decide and accept responsibility for their actions and decisions. In addition, such parents are more likely to encourage academic success, which has a positive correlation with good grades. Authoritative parents invest time and energy in preventing behavioural problems. They also use positive discipline strategies to reinforce good behaviour, like praise and reward systems. According to Roubinov, and Boyce (2017) children raised with authoritative discipline tend to be happy and successful. They are also more likely to be good at making decisions and evaluating safety risks on their own. Researchers like Goode (2015) and Khan (2017) have found that kids who have authoritative parents are most likely to become responsible adults, who feel comfortable in expressing their opinions.

Although permissive parenting also known as indulgent parenting is another style of parenting. These parents are responsive but not demanding. These parents tend to be lenient while trying to avoid confrontation (Atkinson & Hilgard, 2013; Utti, 2016). The benefit of this parenting style is that they are usually very nurturing and loving. The negatives, however, outweigh this benefit. Few rules are set for the children of permissive parents and the rules are inconsistent where they do exist. This lack of structure may cause these children to grow up with little self-discipline and self-control. Some parents adopt this method as an extreme opposite approach to their authoritarian upbringing, while others are simply afraid to do anything that may upset their children. Permissive parents usually take on more of a friendly role than a parent role. They often encourage their children to talk with them about their problems, but they usually do not put much effort into discouraging poor choices or bad behaviours. Kids who grow up with permissive parents are more likely to struggle academically. They may exhibit more behavioural problems as they do not appreciate authority and rules. They often have low self-esteem and may report a lot of sadness. They are also at a higher risk of health problems, like obesity.

Deviant behaviour in learning institutions remains an important issue to educationists and other scholars globally. Deviant behaviour in

Nigeria has become a persistent source of apprehension to parents, school authorities, government and the society at large. The Participation in delinquent acts by adolescents is assuming an alarming proportion and dangerous dimension which are becoming out of control to parents, police and other organs saddled with the responsibility of handling such issues. Deviant behaviour refers to behaviour that does not conform to the norms and expectations of a given group of people or society. Due to the dynamism of the society, various sorts of deviant behaviours such as theft, rudeness, sexual-harassment, truancy, late coming to school and so on are being exhibited in our present dispensation. VanDen-Bos, (2012) defined deviance as "any behaviour that deviates significantly from what is considered appropriate or typical for a social group". Deviant behaviour is an escalating problem in most parts of the world today including Nigeria particularly among secondary school students. Many cases of deviant behaviour have been reported and witnessed across secondary schools. More common ones involving secondary school students include drug and substance abuse, breaking and stealing, burglary, arson, truancy and prostitution. According to Ogidefa (2017), there is hardly any single Nigerian institution of higher learning that has not experienced the menace of cultism. In recent times, schools and the society at large have become reservoirs for committing various sorts of deviant behaviours which include theft, rudeness, sexual-harassment, truancy, late coming to school and so on.

Okpako (2014) carried out a study on Parenting styles as a factor of deviant behaviour among secondary school students in Kwara State. The study was a cross sectional survey of 300 students who were drawn using simple random sampling techniques from six public schools in Kwara state. The Self- Report Deviant Scale was used to for data collection. Data was analysed using multiple regression to test the hypotheses. The results indicated that Authoritative parenting style significantly predicted deviant behaviour among government secondary school students in Kwara state. Duroasro (2016) carried out a study on strategies for managing deviant behaviour among in-school adolescents as expressed by secondary school counsellors in Kwara State. The study adopted the descriptive survey research design method. The target population for this study consisted of secondary school counsellors in the state. Purposive sampling technique was used to select 70 respondents from each of the three senatorial districts in Kwara State. The questionnaire titled "Strategies for Managing Deviant Behaviour Questionnaire" was administered to

the school counsellors. Both descriptive and inferential statistics were used for the data analysis. The findings revealed that deviant behaviour is caused by a lack of effective parental upbringing. It was also found that Permissive parenting style significantly affect deviant behaviour.

Adegoke (2013) conducted a study on how parents influence deviant behavior among adolescents: An Analysis of their Family Life, Community, and Peers. The main purpose of the study was to determine the prevalence of behavioural deviance and perceived parenting styles among higher secondary school students. Descriptive survey was employed as the design. The sampling procedure adopted by the investigator was random sampling (Simple). 403 Higher secondary school students of district Baramullah comprise the sample of the study. Parenting Style Scale by Gupta & Mehtani (2017) and Behaviour Deviance Scale by Chauhan and Aurora (1989) were utilized to collect the data. The collected data was analysed with the use of percentage and frequency counts. It was inferred from the analysis that behavioural deviance is prevalent among 16.27 % of adolescent students and Permissive parenting style significantly correlate deviant behaviour.

While creating their own identity, adolescents may encounter several conflicts, such as learning wrong behaviour from significant people and dealing with their problem in the wrong ways. Parenting style and personality characteristics are paramount in child upbringing otherwise the society will be full of deviant. However, how well these factors can influence deviant behaviour among adolescent is subject to empirical investigation. Hence, this study seeks to investigate the dynamics of parenting styles as correlate of deviant behavior among adolescents in secondary schools in Lagos State.

Problem Statement

Many adolescents are going through a lot especially during their developmental phases as they are often confronted with challenges of kidnapping, internet fraud, alcohol and drug abuse, examination malpractices, increase in deviant behaviours among others. Failure to address this vices poor personality development, low self esteem, value misplacement among others. Many scholars like Ekeh (2014) and Ogidefa (2017) attributed most of these challenges to the nature of parenting styles used by parents in training their children at home especially when they were much younger. Nwokwule, Alika and Egbochuku (2021) asserted that, stealing, fighting, aggressiveness,

rape, cultism and killings have become disturbing and virtually all states of the country have become prone to one crisis or the other. Hence, this study seeks to investigate parenting style as correlate of deviant behaviour among adolescents in Ojo Local Government Area of Lagos State.

Objectives of the Study

The study seeks:

1. To determine how authoritarian parenting style relates with deviant behaviour in adolescents.
2. To ascertain the nature of relationship that exists between authoritative parenting styles and deviant behavior of adolescents
3. To determine how permissive parenting style relates to deviant behaviour in adolescents

Hypotheses

The hypotheses of the study:

1. There is no significant relationship between authoritarian parenting styles and deviant behaviour among adolescents
2. There is no significant relationship between authoritative parenting styles and deviant behaviour among adolescents
3. There is no significant relationship between permissive parenting styles and deviant behaviour among adolescents

Methodology

The research design used for this study was survey research design of a correlational type. This design was considered appropriate because it allows the researcher to determine the relationship between parenting styles and deviant behavior among adolescents. The population for this study comprised of over 24, 914 public senior secondary school students from twelve schools in Ojo Local Government Area of Lagos State. Through simple random sampling technique, this is a technique that affords every participant an equal opportunity of being selected for the study. By this technique the researcher randomly selected sixty (60) adolescents from SS2 classes each from five selected senior secondary schools to form a sample size of 300 participants. The study adapted Deviant Behaviour Variety Scale (DBVS) by Sanches, et al. (2016) and a self-developed

Questionnaire titled Parenting Styles and Adolescents Behaviour Questionnaire (PSABQ) to generate data. The Questionnaire contained 12-items on 3-likert format of Yes, Unsure and No respectively. The instruments (DBVS and PSQ) were scrutinized and validated by three lecturers in the department of Counselling Psychology Education, Lagos State University of Education, Lagos and they were affirmed to meet both content and construct validity. Reliability of the instruments was determined on thirty adolescents in Adeniran Ogunsanya College of Education, Lagos and a reliability index of 0.894 and 0.882 was obtained meaning that the items are suitable for this study. The data generated from this study were analysed through Pearson Product Moment Correlation (PPMC) a correlation analysis and tested at significant level of 0.05 respectively.

Results

H_{01}: There is no significant relationship between authoritarian parenting styles and deviant behaviour among adolescents

Table 1: Correlation analysis showing relationship between authoritarian parenting style and deviant behaviour among adolescents in senior secondary schools

Variables	N	r	sig.(2-tailed)	Decision
Authoritarian parenting Deviant Behaviour	300	.877	.000	Significant

α = 0.05

Table 1 above shows r value of .877 and a p-value of 0.000. Since the p-value is less than the alpha level the null hypothesis which states that Authoritarian parenting style does not significantly relate to deviant behaviour in adolescent is rejected in favour of the alternative hypothesis. Hence, Authoritarian parenting style significantly correlates with deviant behaviour among adolescents. Also, the r-value of 0.877 shows that there is a positive relationship between the independent variable (Authoritarian Parenting style) and the dependent variable (deviant behaviour).

H_{02}: There is no significant relationship between authoritative parenting styles and deviant behaviour among adolescents in senior secondary schools

Table 2: Correlation analysis showing relationship between Authoritative parenting style and deviant behaviour among adolescents in senior secondary schools

Variables	N	r	sig.(2-tailed)	Decision
Authoritative parenting Deviant Behaviour	300	.843	.004	Significant

α = 0.05

Table 2 above shows r value of .843 and p-value of 0.004. From the analysis the r of 0.843 shows that there is a high correlation between the variables (Authoritative parenting styles and deviant behaviour). Testing at 0.05 level of significance the p-value is greater than the alpha level, hence, the null hypothesis is rejected and alternative which states that authoritative parenting style does significantly relate to deviant behaviour especially among adolescents in senior secondary schools is retained.

H_{03}: There is no significant relationship between permissive parenting styles and deviant behaviour among adolescents in senior secondary schools

Table 3: Correlation analysis showing relationship between Permissive parenting style and Deviant behavior among adolescents in senior secondary schools

Variables	N	r	sig.(2-tailed)	Decision
Permissive parenting	300	.739	.013	Significant
Deviant Behaviour				

α = 0.05

Table 3 above shows r value of .739 and p-value of 0.013. Testing at 0.05 level of significance, the p-value (0.013) is less than the alpha level; hence the null hypothesis is rejected and alternative which states that permissive parenting style does significantly relate to deviant behaviour among adolescents in Ojo Local Government Area is retained.

Discussion

From hypothesis 1, it revealed that there is a positive high correlation between Authoritarian parenting style and deviant behaviour among adolescents. This implies that, children who are raised by authoritarian parenting style end up having a behaviour that deviate from the social norm of their society. This finding corroborates with that of Oghiagbephan and Ikekhua, (2013) who established that Authoritarian parenting style significantly correlate with deviant behaviour of adolescents. To them, authoritarian parenting style is a strict parenting style that places high expectations on children. Parents using this style set rigid rules with no explanation and expect their children to obey them without question or face severe punishment.

From hypothesis 2, the result revealed that there is a positive correlation between Authoritative parenting style and deviant

behaviour among adolescents. This finding is in consonance with that of Okpako (2014); Amaechi and Onah, (2016) who stated that authoritative parenting style goes a long way to predicting possible deviant behaviour among adolescents. Under this parenting style, parents are seen to be nurturers, responsive and supportive yet set firm limits for their children. They tend to control children's behavior by explaining rules, discussing and reasoning. Due to their keen monitoring of their children its very easy to identify certain behaviours not seen as welcoming at any point in time.

From hypothesis 3 it revealed that permissive parenting style has a positive correlation with deviant behavior among adolescents in senior secondary schools. This work conforms to that of Duroasro (2016), who found that permissive parenting style significantly affect deviant behaviour among adolescent. Permissive parenting styles tend to be warm and nurturing and usually have minimal expectations. They impose rules on their children, establish communication link while same parents allows their children to figure out things for themselves. This implies that when children are raised with permissive parenting style they grow up with established bonds and rules while some seldom deviate from the social norm of the society. Moreso, Akingbade (2021) further stated that permissive parents are always receptive, warm and maintain an open door policy that is designed to accommodate excesses of their wards. This kind of parenting styles breed children to be adventurous and prone to discovery by themselves which in turn affects the extent of deviant behavior among adolescents especially in secondary schools.

Conclusion

Based on the findings of this study, it was concluded that parenting styles correlate to deviant behaviours in adolescent especially in Ojo L.G.A of Lagos State significantly. The study also concluded among others that parents should apply some form or degree of direction, caution and guidance because it goes a long way to preventing adolescents from engaging in deviant behaviours in future. Also, permissive parenting type may sometimes not produce the expected behaviour demanded by parents as some adolescents may deviate from the norm due to the permissive and free will given to them by their parents to choose what they want in life.

Recommendation

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

1. Parents should be positive oriented in their styles of child's parenting which will make their adolescents socially competent and goal directed.
2. Dialogue, communication, explanations and establishment of good and cordial relationships between parents and adolescents should be established.
3. Government should establish psychological service centres in schools and engage the services of psychologists to counsel and modify the negative traits of deviant students. This will help in reducing the occurrences of deviant activities among secondary school students.

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Rima International Journal of Education (RIJE), Vol. 3 (No. 3): Nov 2024; page: 45-54 ISSN: 2756 - 6749

Reliability of Digital Literacy Scale on Academic Performance of Pre-service Teachers in Early Childhood Caregivers in Ojo LGA, Lagos State

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Abstract

The study investigated reliability of digital literacy scale on academic performance of Pre-service teachers in Early Childhood in Ojo, LGA, Lagos State. The objective of this work was out to determine the effect of digital literacy training on academic performance of pre-service teachers as 2x2 schematic design of true-experimental research design was adopted to randomise participants. The study was carried out among pre-service caregivers in Lagos State University of Education, LASUED. Target population comprised of 200 level undergraduates of sixty participants selected sample (30 experimental and 30 control group participants). Purposive sampling technique was used to select participant. An adapted 15-item 2022/2023 First Semester Achievement Test on Educational Technology and another adapted 15-item on Digital Literacy Scale (DLS) a 3-point scale instrument was used for data collection. Content validity was ensured through the use of Cronbach alpha, a reliability index of 0.864 and 0.890 was derived, meaning that the instruments are suitable for use and t-test statistics was used to analyse the data. The study revealed that participants in the experimental group performed better than those in the control group due to effective training and exposure given to them, hence, all null hypotheses rejected and alternative retained. The study concluded that the adapted digital literacy scale remains a reliable instrument for the improvement of academic performance of students. Among others the study recommended that Digital literacy training should be extended to students in public secondary schools.

Key Words: Academic performance, Reliability, Digital Literacy, Achievement, Technology

Introduction

The impact of digital technology cannot be under estimated in the school system owing to numerous positives associated with effective classroom activities and exposure. A student will find the classroom interactive and interesting when instructions are delivered through to digital platform, the 21st century tool for academic advancement. Teaching activity is expected to be expository, mind/eye-opening, informative, educative and entertaining since teaching is backed by technology. Because teaching must follow the sequence of simple to

complex, known to unknown, physical to abstract, therefore it becomes imperative that teaching must be backed by the use of technology (Khodabandeh, 2022).

The concept of digital technology is often considered to include the use of electronic gadgets such as handsets, electronic toys, robots, SMART boards and cards, video machines, projector, applications as Zoom, WhatsApp and the use of internet for information dissemination to enhance effective teaching and learning in schools (Obiweluozo, Onwurah, Oraelosi, Uzodinma, & Dike, 2021). Digital technology tools, resources, systems and gadgets help in data generation, storage and processing for future use. The easy access to Information and Communication Technology ICT, have transformed every aspect of human existence particularly in the area of teaching and learning. In reality if children must survive and succeed with the increasing roles of digital technologies required in this fourth industrial revolution era that has significantly become part of our culture at home, immediate environment, school digital learning must be seen as an integral part of learning in school curriculum of teacher training institutions. According to a study by Morrison (2012) it highlighted some commonly used digitally used techies in education to include computers, educational robots, mobile devices such as Smart phones and Tablets, Smart boards, internet, cameras, iPhones, iPads, digital cameras, online games, social media, mobile phones multimedia among others supported by Apps.

The term digital literacy sterns from exposure, enlightenment, education, critical thinking, content mastery and assimilation. Digital literacy most times flows well among children whose hearts are still fragile and exposed to innovations. Scholars have advocated that early childhood education is an education given to children below five years old. NERDC (2017) on its own part views early childhood care or early childhood education as initial stage of organised instruction designed primarily, to introduce young children to a school-type environment. It serves as a bridge between the home and a school-based atmosphere. Federal Republic of Nigeria in her National Policy on Education (FRN, 2019) conceptualise it as education given to children in an educational institution prior to their entering into primary school. Children at this level of education are digital natives. Obiweluozo, et al (2021) asserts that children born into a digital world where the web, podcast and Google are basic vocabulary words require a high level of engagement in their learning to survive and succeed. They read, write and think digitally. Thus, provision of digital technology in the

classroom is vital to support teaching and learning of science engineering and technology activities.

According to Cirfat, Katniyon and Duguryil (2022), the incorporation of digital technology encourages active learning, knowledge construction inquiry and exploration. These devices make it easier for remote communication as well as data sharing to take place between teachers and learners in different physical classroom locations (Katniyon, 2016). Obiweluozo, Onwurah, Oraelosi, Uzodinma & Dike (2021) affirmed that the general use of technology in classrooms increases motivation, improvement in self-concept, mastery of basic skill, enhancement of learner-centred learning and engagement in the learning process. Digital technology can also be used as a scaffolding tool in the early childhood classroom. For instance, digital cameras can be used to create literacy activities for the children. These digital cameras can also be used to document children's learning; daily documentation, wall displays, portfolios (Khodabandeh, 2022). They can be used to create electronic books, child-created books, among others. Digital technology enables children to use Google Earth, an online resource to virtually visit a location they have been learning about. Integrating technologies in learning puts a great role on the teacher as he plays a critical role in the effective use of digital technologies in early childhood classroom.

Competence refers to teachers' knowledge, skills and attitude in using digital literacy and equipment to deliver on classroom learning outcomes. Teachers' competence in the use of digital technologies involves the ability to utilize presentation skills, educational robotics skills, internet usage and all other digital related skills effectively to perform various activities inside and outside the classroom. Early childhood school teachers need the competencies pertinent for the effective use of digital technology in a play based manner in the classroom to allow children to be able to perform tasks, solve problems, communicate, collaborate as well as to create and share contents towards encouraging critical thinking in children.

One of the key competencies needed by teachers in classroom situation include digital presentation skills, educational robotics skills and internet usage skills. Presentation skill is an essential skill in teaching and learning, especially when using computer. Presentation skills include content of subject matter as well as flow of presentation. Information can be presented using zoom, WhatsApp, Google classroom and Power Point projectors. With digital technology,

concepts that are difficult to explain, can be easily presented to the children in a simple way using any presentation software with audio, video and other animations to further aid understanding. PowerPoint presentation can be used to promote emotional intelligence of children, social competence, and curriculum implementation, among others. It affords a teacher the opportunity to incorporate visual and auditory aspect to presentation. It allows variety of manipulations by editing or text modification, removal of existing slides and addition of new slides to make lesson more organised and flexible (Gambari, Yusuf and Balogun 2015).

One important and globally relevant digital learning tool is the internet. Internet is network of global computers interconnected to each other and available to any individual. Uses of the internet includes communication, teaching and learning and dissemination of information, basic processes, operating system basics, software installation from removable, media, step by step downloading software, creating the upload page, create or open a web among others.

However in the teaching and learning environment, the use of digital technology has impacted positively on the performance of learners. Udofia (2023) described academic performance as academic outcomes that indicate the extent to which a learner has achieved specific learning goals. Udofia stressed that academic performance can also refer to completing educational benchmarks such as moving from a lower state to higher one and obtaining a certificate. Performance is often measured through examination or continuous assessment. Since performance is dependent on the degree of content mastered, teachers and other stakeholders are brainstorming on the various facets digital technology can be best maximised in the improvement of academic performance of pupils.

Statement of Problem

A growing trend today is that children have become technologically exposed daily in areas such as gaming, play toys, phones, laptops, and computers, television, and videos at home and outside the home. Sadly, most teachers especially those teaching at the early childhood levels may not be digitally literate (Obiweluozo, et al. 2021). Early childhood school teachers may appear to lack the prerequisite skills towards internet usage, Apps presentation, Internet of Things (IOT), use of packages among others. It is unclear if most teachers lack the competencies in the use of information technologies to procure,

process, store, print and retrieve information from computers and internet. Previous study by Palaiologou (2016) asserted that early childhood teachers may lack Information and Technology knowledge which are needed to enhance use of digital technology. This knowledge if not well utilised may affect academic performance. It is against this background that this study seeks to investigate the reliability of Digital Literacy Scale on Academic Performance of Early Childhood Caregivers especially among pre-service teachers in Ojo LGA of Lagos State.

Objectives of the Study

The study seeks:

1. To investigate the effect of digital literacy training on academic performance of pre-service teachers by pre-post test in experimental group.
2. To identify the effect of digital literacy training on academic performance of pre-service teachers by post-test experimental control groups.

Hypotheses

The hypotheses of the study:

1. Digital literacy training does not have any significant effect on academic performance of pre-service teachers by pre-post test in experimental group.
2. Digital literacy training does not have any significant effect on academic performance of pre-service teachers by post-test experimental control groups.

Significant of the study

1. Academics in tertiary institutions would find this study useful as it affords them the opportunity to determine the appropriate digital literacy scale suited for students in tertiary institutions.
2. Researchers on their own part would find this study relevant as it would aid in contemporary update of information needed in the area of digital literacy.
3. Measurement and evaluation practitioners would also find this work useful as it will guide them in evaluation of digital literacy.
4. Caregivers will find the outcome of this work useful because it would encourage them to intensify the use of digital literacy

mode to teach children in classrooms. This action would also prompt parents to provide children with tech friendly apps that encourage learning.

Methodology

The study adopted true-experimental research design. This design type is used when the researcher has the ability to randomise participants, manipulate and control outcome of behaviours in a study. Experimental and control groups was formed for this study. A 2x2 Schematic type was used for the study as represented below:

E1: O11 X1 O12 (Pretested group with treatment)

C2: O21 O22 (Control group without treatment)

*Where O11, O21 → represent Pre-test measures

O12, O22 → represents Post-test measures

X1 --- represents Treatment conditions.

The study was carried out among pre-service caregivers in the Lagos State University of Education, Epe campus of LASUED. The population of the study was all undergraduates in same institution while the target population comprised of 200 level undergraduates. Two sampling technique comprising of purposive and simple random techniques were used to select participant. They were seen as the best technique to use because they captured the appropriate participants meant for the work and also gives every participant an equal chance of been selected for this study. First, purposive sampling technique was used to identify Pre-service teachers from Department of Early Childhood Care Education, in College of Specialised and Primary Education, COSPED, thereafter simple random sampling technique was used to select a sample size of sixty participants for this work. 30 participants formed experimental group and another 30 form control group respectively. This technique gives every participant an equal opportunity of been selected for the study. An adapted 15-item 2022/2023 First Semester Achievement Test on Digital Literacy Education (15-FSATDLE) from University of Benin, Benin City and another adapted Digital Literacy Scale (DLS) by Denis, et al. (2010) a 3-point scale instrument. This scale was adapted from 21-items to 12-items format in relation to the level of participants. Two academics in the department of Educational Technology, Lagos State University of Education, Ijanikin, Lagos state, determined the validity of the

instrument as content validity was met. Through the use of Cronbach alpha, a reliability index of 0.864 and 0.890 was derived, meaning that both instruments are suitable for use. Z and T-score was used to transform data from the scale to allow for normality. However, the experimental group was exposed to a treatment measure of instruction or training that would assist them in effective manipulation of technology use in two weeks. Interaction with the experimental group took place once every week for two weeks. The control group was exposed to a general talk on classroom interaction (Dummy). T-test statistics was used to analyse the data and tested at significant level of 0.05 respectively.

Results

H_{01}: Digital literacy training does not have any significant effect on academic performance of pre-service caregivers by pre-post test in experimental and control group

Table 1: Effect of digital literacy training on academic performance of pre-service caregivers by pre-post test in experimental group

Groups	X	SD	P-val.	t-cal.	Sig.	Remarks
Pre-test	2.49	0.69	0.05	1.99	0.006	Reject $H0_1$
Post-test	3.37	0.74				

Source: Research Work, 2024

From the data above it is observed that the pre-test group recorded a lower mean and standard deviation values as against that of post-test group. With t-cal. value of 2.96, P-value > 0.006, hence the null hypothesis formulated is rejected and alternative hypothesis which states that digital literacy training has a significant effect on academic performance of pre-service caregivers in experimental group.

H_{02}: Digital literacy training does not have any significant effect on academic performance of pre-service caregivers by post-tests in experimental and control groups

Table 2: Effect of digital literacy training on academic performance of pre-service caregivers by post-tests in experimental and control groups

Groups	X	SD	P-val.	t-cal.	Sig.	Remarks
Post-test (Exp)	3.14	0.525	0.05	3.09	0.017	Reject $H0_2$
Post-test (Con)	3.79	0.831				

Source: Research Work, 2024

From Table 2 above, it is observed that the post-test (experimental) group recorded a higher mean and standard deviation values as

against that of post-test (experimental) group. With t-cal. value of 3.09, P-value > 0.017, hence the null hypothesis formulated is rejected and alternative hypothesis which states that digital literacy training have a significant effect on academic performance of pre-service caregivers in post-test experimental control groups.

Discussion

From the one it reveals that digital literacy training has significant effect on academic performance of pre-service caregivers by pre-post test in experimental group. It is expected that a well developed training package would expose pre-service teachers to improvement in actions. Due to the exposure of students to sets of developed training programmes on how to maximise digital platforms effectively either in the area of Apps manipulation and effective utilisation in classrooms or for teaching purposes, their performances are expected to improve. This study conforms to that of Obiweluozo, et al. (2021) who affirms that the general use of a carefully planned digital technology activity in classrooms have the likelihood to increase motivation, improvement in self-concept, mastery of basic skill, enhancement of learner-centred learning and engagement in the learning process. Since digital technology or digital literacy can be used to enhance scaffolding mastery and manipulation at a early stage in life, it also have the probability of functioning efficiently in classrooms.

Meanwhile hypothesis two reveals that digital literacy training have a significant effect on academic performance of pre-service caregivers especially in post-test experimental control groups. It is an expectation that the effect of a training package would be carefully observed by way of outcome condition. The study upholds that due to enlightenment and planned activity of training, academic performance of students is bound to experience a systematic change and expectation as seen in the experimental group. The intervention of any sort and manner is bound to be seen on the academic performance of stakeholders and students respectively. The outcome of this work conforms to that of Cirfat, Katniyon and Duguryil (2022) alongside Katniyon (2016) claimed that the incorporation of digital literacy skills encourages active learning, knowledge construction inquiry and exploration. These devices make it easier for remote communication as well as data sharing to take place between teachers and learners in different physical classroom locations. Against all odds it increases motivation, improvement in self-concept, mastery of basic skill,

enhancement of learner-centred learning and engagement in classroom learning process.

Conclusion

Having advance the role played by reliable digital literacy scale on academic performance of early childhood caregivers especially in Ojo local government area, the study concluded that digital literacy skill remains a functional tool in the 21st century that can be used to enhance academic performance of early childhood caregiver trainees in the state. The study also concludes that use knowledge on the use of digital literacy goes a long way to aid content assimilation, mastery and development of critical thinking skills.

Recommendation

Digital literacy entails the knowledge acquired through ones' interaction with technology. The study among others recommended the following after rigorous study:

1. Digital literacy training should be extended to students in public secondary schools
2. Teachers should be exposed to the techniques in test development especially as it concerns digital literacy content.
3. Digital literacy should be made compulsory for all undergraduates in tertiary institution.

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Rima International Journal of Education (RIJE), Vol. 3 (No. 3): Nov 2024; page: 55-65 ISSN: 2756 - 6749

Socioeconomic Activites and Insecurity Situations in Isa Local Government Area of Sokoto State

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Abstract

The main objective of this research paper is to examine the socioeconomic activities and insecurity situations in Isah local Government of Sokoto State. Three objectives, research questions and three hypotheses were formulated. The correlational research design was adopted to discover the extent of relationship that exists between the variables. The total number of 354 was purposively selected for the study. Result shows that Farming activities is more related to Security Challenge and a better predictor of Working in the other places in the state than their Business activities. Based on the result researchers recommended that the government should try to discharge its responsibility for public safety at all levels, runs by the local, state and federal governments. This will enable the people to go out and engage in farming, business and government work without a doubt that the terrorists have violated their rights.

Key Words: Coping, Challenges and Insecurity

Introduction

Insecurity is a critical issue that has hampered sustainable development in Nigeria in particular and Africa at large. Nigeria which is perceived as the giant of Africa has witnessed an unprecedented incidences of insecurity ranging from the activities of Fulani Herdsmen: Boko Haram Insurgencies, Armed Robber Attacks, kidnapping, political/religious crisis, murder, destruction of oil facilities by Niger Delta militants, Child Abduction, Trafficking etc. Other crimes committed include: destruction of vehicles; burning of Mosques, Churches, Police stations, Schools, Hospitals, clinics, shops, army barracks and residential houses; abduction of expatriates. These challenges have made security a pivotal issue that has culminated in the allocation of country's meager resources to the protection of lives and properties.

In security has been a concern in Sokoto State, Nigeria, with issues such as banditry, insurgency, and communal conflicts affecting the region. Efforts have been made by the government and security

agencies to address these challenges and restore peace. However, coping with the insecurity challenges in Sokoto State requires a multi-faceted approach. This might involve strengthening law enforcement, improving intelligence gathering, promoting community engagement and investing in socio-economic development. Collaborative efforts between government, security agencies, local communities and NGO's can create a safer environment and address the root causes of insecurity. Isa is a local government area in Sokoto State, Nigeria. Its headquarters were in the town of Isa. It has an area of 868 km2 and a population of 281,367 at 2006 cencus. Isa also, is affected with issue of insecurity. Residents of Sububu, Kuka tara, Tsabre, Modaci, Lugu, Bargaja, Dan Zanke, Gazau, Turba, Gawa kuke, Kaibaba, Gatawa, Rijiyar Malam Ladan, Gidan nagora, Daborawa, Madattai and other surrounding communities in Isa local government area of Sokoto State protest incessant killings and rising insecurity in the state. The protesters blocked the ever busy Isa Gundumi highway putting business activities on hold. They want government and security agencies to secure communities from armed bandits attack and kidnapping especially as farming season commences.

Conceptual Framework

The concept of national security remains ambiguous, having evolved from simpler definitions which emphasized freedom from military threat and from political coercion. Among the many definitions proposed to date were the following, which show how the concept has evolved to encompass non-military concerns. A nation has security when it does not have to sacrifice its legitimate interests to avoid war, and is able, if challenged, to maintain them by war (Walter Lippmann, 1943). The distinctive meaning of national security means freedom from foreign dictation (Harold Lasswell, 1950). National security objectively means the absence of threats to acquired values and subjectively, the absence of fear that such values will be attacked (Arnold Wolfers, 1960). National security then is the ability to preserve the nation's physical integrity and territory; to maintain its economic relations with the rest of the world on reasonable terms; to preserve its nature, institution, and governance from disruption from outside; and to control its borders (Harold Brown, U.S. Secretary of Defense, 1977-1981).

National security is best described as a capacity to control those domestic and foreign conditions that the public opinion of a given community believes necessary to enjoy its own self-determination or

autonomy, prosperity, and wellbeing (Charles, 1990). National security is an appropriate and aggressive blend of political resilience and maturity, human resmyces, economic structure and capacity, technological competence, industrial base and availability of natural resmyces and finally the military might. (National Defence College of India, 1996). National security is the measurable state of the capability of a nation to overcome the multi-dimensional threats to the appwerent well-being of its people and its survival as a nation-state at any given time, by balancing all instruments of state policy through governance and is extendable to global security by variables external to it (Prabhakaran, 2008). National and international security may be understood as showered freedom from fear and want, and the freedom to live in dignity. It implies social and ecological health rather than the absence of risk and is a common right (Ammerdown, 2016).

In security in Nigeria include bombing, suicide bomb attacks, sporadic shooting of unarmed and innocent citizens, burning of police stations, churches, kidnapping of school girls and women. Kidnapping, rape, armed robbery and political crises, murder, destruction of oil facilities by un patriotic Nigerians. Insecurity and terrorism has been major challenges to the Nigerian government in recent times. The activities of the Islamic sect (Boko Haram) and Banditry activities had led to loss of lives and properties in the country especially in the Northern part of Nigeria. The events surrounding September 11, 2001 and other recent events of terrorism across the globe especially the current wave of terrorism in Nigeria, had focused my minds on issues of terrorism and insecurity. It has made government to divert resmyces meant for development purposes to security votes. Expenditure made by government on security matters had significantly and positively impacted on economic development implying that expenditure on security matters has helped to ameliorate the negative effect of terrorism and insecurity despite the fact there is a crowding-in effect of security expenditure on economic development.

Sokoto State the Site of the Caliphate is believed to be as one of the states in Nigeria where citizens were proud to be farmers, and the state has no doubt lived up to its slogan of "Site of the Caliphate". Isa Local Government is a town and Local Government Area of Sokoto State, Nigeria. It shares borders with Shinkafi in Zamfara State, Goronyo and Sabon Birni from west and north respectively in Sokoto and the Republic of Niger in the east. It has an area of 2,158 Km2 and a population of 146,103 at 2006 Cencus. The postal code of the area is 842. The local government of Isa is made up of the capital towns

and villages such as Turba, birth place of the former Sokoto State Governor and 2007 Presidential candidate Alhaji Attahiru Dalhatu Bafarawa. Historically the area was a part of the ancient kingdom of Gobir and is inhabited by members of the Fulani ethnic groups. Other villages under Isa Local Government are: Sububu, Kuka Tara, Tsabre, Modaci, Lugu, Dan Zanke, Gazau, Turba, Gawa kuke, Kaibaba, gatawa, Rijiyar malam Ladan, Gidan nagora, Madattai.

The abduction of people and excessive killing in Isa was one of the major challenges in the area. Also, 18 sitters Bus were attacks by criminals and they were burnt to ashes at Gidan Bawa town that placed the state on national and international stage negatively. Despite efforts by past and present administrations in the state as well as the Federal Government, it has remained a den of notorious criminal non-state actors, who have become entrenched. Like with all such criminal non-state actors, there activities have continued to impact negatively on the lives and livelihood of the people of the state who were largely farmers – both small and large scale. While those in the state were direct victims of the activities of these criminals, citizens of the state who reside outside it were also collateral victims as they can no longer travel home with their families for visits during festivals. In the same wise, commercial and business activities have been affected.

Theoretical Framework

A Constructivist Approach to Security and National Security Before one can aspire to understand national security exhaustively, it is essential to, first of all, understand what security is. The complexity of security as a concept means that its clarification is a requirement for anyone attempting to discuss national security. Security has been defined as a state of feeling safe and the absence of fear, anxiety, danger, poverty and oppression and that that security is the preservation of core values and the absence of threats to these values. Security was also defined by Zabadi as a state within which people or things were not exposed to the danger of physical or moral aggression, accident, theft or decline. Zabadi also viewed the state as the primary provider of security towards its citizens, utilising power and force to provide security if need be. Constructivism is not a theory of international relations or security. It is more of a broader social theory which then informs how we might approach the study of security.

Statement of Problem

The predicament in which security challenges has placed in Isa Local Government of Sokoto State is unquantifiable. The local governments endowed with both human and natural resmyces were suffering from severe pangs of hunger to the detriment of the citizenry. This scenario has prompted many youths to engage in nefarious and precarious activities such as armed robbery, kidnapping, child abduction etc. Youths who were leaders of tomorrow were neglected. This ugly situation has resulted in migration of youths from one country to the other, from one state to the other in search of greener pastures where many have lost their lives. Therefore, it is very clear that the state of insecurity in Isa Local Government town is largely a function of government failure and lackadaisical attitude towards the poor masses. This is showcased by the inability of government to deliver public services and to provide basic needs for the masses like shelter, food and clothing, educational and farming activities. The paucity of basic needs by the people of the local government in the state has created a pool of frustrated people who were ignited easily by any event to be violent.

The argument here, is that, Nigeria has the remises to provide for the needs of her people, in the states and local governments, but corruption in public offices at all levels has made it impossible for office holders to focus on the provision of basic needs and security for the people. Federal and Sokoto State government did not provide citizens of Isa Local Government Local government with the security to continue with their businesses and farming activities which lead a serious poverty in the area. Deputy Chief Imam of Isa Central Mosque was a victim of bandit's attack on his way to Isa town; they collected ransom before he regains his freedom. These were challenges that this research investigated: Unrest, Lost of connection between rural and Urban, Business activities, unable to farm in their farms, uncertainty of their lives due to the bandits attacks, loosing of valuable items like cows, sheeps and goats, Rape/Kidnapping of young girls', loosing of incomes and lack of education e.t.c. These insecurity situations informed the researcher, choice to write on the topic coping with Challenges of Insecurity in Isa Local Government Local Government area of Sokoto State.

Objectives of the Study

The objectives of this study were:

1. To examine the relationship between security challenge and business activities in Isa Local Government in Sokoto State, and
2. To examine the relationship between security challenge and faming activity in Isa Local Government in Sokoto State.

Research Questions

The following were the research questions that this research will answer:

1. Is there any relationship between security challenge and business activities in Isa Local Government Local Government in Sokoto State?
2. Is there any relationship between security challenge and faming activity in Isa Local Government Local Government in Sokoto State?
3. Is a security challenge a better predictor of Isa Local Government citizens working in other local governments in the State?

Hypothese

The following null hypotheses were formulated:

1. That there is no significant relationship between security challenge and business activities in Isa Local Government in Sokoto State.
2. That there is no significant relationship between security challenge and faming activity in Isa Local Government in Sokoto State.
3. That security challenge is a better predictor of Isa Local Government citizens working in other Local Governments in the State.

Methodology

The research is a correlational type of survey design. The correlational research design was chosen because it is the appropriate for all research work in which attempt was made to discover or clarify the extent of relationship that exists between two or more variables through the use of correlational statistics method. It was adopted in this study because it allows the researcher to measure and determine the degree of relationship between two or more variables leading to predictions, inferences or conclusion. The population for the study

includes the entire people of Isa Local Government of Sokoto State. It has an area of 2,158 Km2 and a population of one hundred and forty six thousand one hundred and three (146,103) at 2006 Cencus. The postal code of the area is 842.

The researcher used purposive sampling technique to select sample of this study. These include people of Isa, Tsabre, Modaci, Gatarawa and Gidan Nagora. According to Salawu (1991), if within a population there were certain elements the researcher believes were of particular concern to his study, the only way to ensure this was to deliberately select them. Through the use of Krejcie, and Morgan table therefore a total sample size of 354 respondents from the five (5) villages of Isa Local Government. The selected respondents were arrived at. In recognition of this view, the researcher decided not to include the remaining villages. The 354 respondents comprised Isa Town, Modaci, Gatawa, Gidan Nagora and Madattai. The table below shows the breakdown of the respondents:

Table 1: Population and Sample Size

S/N	Area	Population	Sample
1	Isah Town	850	27
2	Modaci	522	45
3	Gatawa	290	25
4	Gidan Nagora	235	43
5	Madattai	108	25
	Total	**2,005**	**354**

Source: Isa Local government 2023

The instrument used in collecting relevant information for this study is Self developed instrument on Banditry and its Influence to the life style of People Isa (BILP). The instrument (questionnaire) was developed by the researcher, to measure perception of how their Current situation on Farming and business activities in the area even with the treat of banditry activities. The instrument has 30 items. The questionnaire measured the following aspects namely, Faming, lack of schooling, fear and anxiety and lack of business activities.

Results

H_{01}: That there is no significant relationship between security challenges and business activities in Isa Local Government in Sokoto State.

The hypothesis was tested by subjecting the respondents' scores of Security challenges and business activity to Pearson's correlation analysis as shown in table.

Table 1: Relationship between Security challenge and Business Activities

Variables	N	Mean	Std. Deviation	r-Cal	*p*-Value	Decision
Security challenges	354	164.56	18.113	.025	.646	H0 Fail to Reject
Business Activities	354	100.45	36.395			

Results of table indicated that the relationship of Security challenges and business activities though positive was not significant, Pearson's r(352) = .025, p = .646. This indicates no significant relationship between Security challenges and business activities because the p-value is more than the .05 level of significance. Therefore, H01 which states that there is no significant relationship between Security challenges and business activities in Isa Local Government was accepted.

H_{02}: That there is no significant relationship between security challenge and faming activity in Isa Local Government in Sokoto State

The hypothesis was tested by subjecting the respondents' scores of security challenge and faming activity to Pearson's correlation analysis as shown in table.

Table 2: Relationship between security challenge and faming activity

Variables	N	Mean	Std. Deviation	r-Cal	*p*-Value	Decision
Security Challenge	354	103.37	8.860	.184	.001	H0 Rejected
Farming Activity	354	100.45	36.395			

Results of table indicated that the relationship of students' security challenge and faming activity positive and significant, Pearson's r(352) = .184, p = .001. This indicates a significant relationship between security challenge and faming activity because the p-value is less than the .05 level of significance. Therefore, H02 which states that there is no significant relationship between security challenge and faming activity in Isa Local Government was rejected.

H_{03}: That security challenge is a better predictor of Isa citizens working in other Local Governments in the State.

This hypothesis was tested by subjecting the respondents' scores of citizen working in other local governments in the state to regression analysis to predict academic performance of the students as shown in table.

Table 3: Farming activity and Business activity Prediction to Security Challenge

Variables	R	R^2	Adjusted R^2	SE	F	*B*	T	*p*-value

Farming	.005	.000	-.003	36.446	.009	.019	.333	.739
Workers	.008	.000	-.006	36.497	.011	-.001	-.014	.989
Insecurity	.062	.004	-.005	36.481	.446	.076	1.450	.148
Business	.200	.040	.029	35.865	3.63	.191	3.622	.000

Dependent Variable: Security Challenge

A look at the squared part correlations revealed that Farming activity accounted for 0.0% of the variance in security challenge R2 adj = -.003, F (1, 352) = .009, p > .05 and that workers accounted also for 0.0% of the variance in Security challenge R2 adj = -.006, F (2, 351) = .011, p > .05. Likewise, it also revealed that insecurity accounted for 0.4% of the variance in security challenge R2 adj = -.005, F (3, 350) = .446, p > .05 and finally, that business accounted for 4.0% of the variance R2 adj = .029, F (4, 349) = 3.63, p < .05. Thus, the significant results of the procedure indicated that the predictor variables were able to account for a significant amount of variance in the dependent variable.

Although farming, demanding, insecurity and business were explanatory variables of Security Challenge, analysis of regression coefficients indicated that business, β = .191, t = 3.622, p < .05 emerged as the significant predictor when all variables were in the model. This indicated that business is a better predictor of security challenge than workers. Therefore, the hypothesis is accepted. Thus, then it is concluded that farming was more related to the security challenge than their business in Isa Local Government of Sokoto State.

Discussion

Security challenges are both an issue in developing as well as in developed countries. Several efforts are made to resolve security concerns globally. However, despite the increased struggle to solve security issues, majorities of the world's population are still faced with preventable internal security challenges; this is mainly in Africa and the Middle East. For many countries, achieving development is not only dependent on economic ability, and asset management but also the state of security of affairs within and outside its horizon.

It can be argued that the essence of maintaining peace and security is for the wellbeing of people in a society.

Results indicated that the relationship of Security challenges and business activities though positive was not significant, Pearson's r(352) = .025, p = .646. This indicates no significant relationship

between Security challenges and business activities because the p-value is more than the .05 level of significance. Therefore, the null hypothesis which states that there is no significant relationship between Security challenges and business activities in Isa Local Government cannot be rejected. This in line with Kim et al suggest that low levels of human development increases the risk of conflict outbreaks and recurrence; therefore this implies that to prevent conflict more projects are to be embarked on to promote human development and this will in turn reflect on the overall security of the country. The protection of lives especially at the grassroots' level is crucial to the overall security of a nation. Also, The Open Society Initiative for West Africa (OSIWA) recognizes four main causes of crisis outbreak in Nigeria; the report blames this on growing economic issues, an increase in organized crime, unproductive government and policies that people have no confidence in, and lastly political differences and election mayhem (OSIWA, 2012). This report goes further, to state that without prompt interference from the international community, the already existing issues might develop into more worsening security problems not only to the country but also to other regions surrounding it. The major challenges faced by the people of Isa local government are banditry activities which destroyed their business, faming and working in their local government .area. The first hypothesis shows that there was significant relationship between security challenge and faming activity. Also, farming activities is more related to Security Challenge. Lastly, results indicated that the predictor variables were able to account for a significant amount of variance in the dependent variable.

Conclusion

From the findings and discussion of results, it was concluded that the relationship of security challenges and business activities in Isa local government was positive though not significant. Conclusively then, low levels of human development increase the risk of conflict outbreaks and recurrence.

Recommendation

1. The government should try to discharge its responsibility for public safety at all levels by improving security situation and human development to avoid the risk of conflict outbreak. This will enable the people to go out and engage in farming, business

and government work without a doubt that the terrorists have violated their rights.

2. The government should identify the vigilante group and volunteers with the cooperation of security operatives to infiltrate the Isa local Government area, to identify the bandits, Kidnappers and punish them according to shari'a law.
3. Sokoto State Government should provide food and basic necessities to the people of Isa, Sububu, Kuka tara, Tsabre, Modaci, Lugu, Dan zanke, Gazau, Turba, Gawa kuke, Kaibaba, Gatarawa, Bargaja, Daborawa, Gidan Gora and Madattai to alleviate the suffering of farmers, business and local government employees in Isa Local Government area.

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Perceived Lecturers' Awareness on the Use of Artificial Intelligence Platforms for Teaching in Colleges of Education, Yobe State, Nigeria

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Abstract

The study investigated perceived lecturers' awareness of using Artificial Intelligence (AI) for teaching in colleges of education, in Yobe State, Nigeria. The study adopted a descriptive survey design. The study was guided by two research objectives and two research questions. The study's target population was 146 lecturers from three Colleges of Education in Yobe State. A random sampling technique was used to determine the sample from the population. The sample has a total population of 121 lecturers. The sample size was obtained using the Krejcie and Morgan table for sample size. The instrument used for data collection was a questionnaire titled "Perceived lecturers, Awareness on use of artificial intelligence for teaching and learning" and validated by six experts. It was also pilot-tested at Sir Kashim Ibrahim College of Education, Maiduguri. The result of pilot testing was analyzed using Cronbach alpha and yielded a reliability coefficient of 0.593 and 0.727 respectively. Frequency count and percentage were used to analyze the demographic data, mean and standard deviation were used to answer the research questions and Kruskalwalli's non-parametric tests were used in testing the null hypotheses. From the result, both null hypotheses were rejected. The study revealed that lecturers perceived that artificial intelligence is useful for teaching and learning in Colleges of Education (mean score of 3.11) and lecturers perceived artificial intelligence as easy to use in teaching and learning in Colleges of Education (mean score of 2.79). There is a significant difference in the lecturers' level of perceived usefulness of artificial intelligence in teaching and learning based on their years of experience and it is hereby rejected (H-test = 102.399, df = 2, p = 0.000) and there is a significant difference on the lecturers' level perceived ease of use of artificial intelligence platform in teaching and learning based on their schools (H-test = 96.829, df = 2, p = 0.000). It is therefore recommended that Governments and Non-Government

Organizations (NGOs) should encourage lecturers' by organizing sensitization workshops for them, to enlighten them on the existence and importance of artificial intelligence for teaching and learning in Colleges of Education in such a way that it will make them more aware of the resourcefulness of Artificial Intelligence (AI).

Key Words: Lecturers; Artificial Intelligence; Perceived Usefulness; Perceived ease of use

Introduction

Information Communications Technology devices are currently becoming more creative, not only the use of computers but also include links to the internet. It enables distance learning to take place in which students and instructors are not limited by time and freedom to interact and conduct the learning process, either synchronously or asynchronously. Synchronous distance learning situation is where the lecturer and students convene at the same time but in different locations, while asynchronous distance learning takes place where the location in which both the time and place are different (Newby, 2011).

Information and Communication Technology (ICT) are tools for both students and teachers. ICT has the possibility of being used to meet up with the learning desires of students, increase self-efficiency and freedom of learning among students and improve students' progress. ICT is the integration of communication technologies such as telecommunication, computers and the Internet to manage and transmit information in various formats (Sharma, 2015).

Awareness refers to familiarity with understanding and uses of technological tools, and platform band systems (Fry & Lenhart, 2018). It also involves recognizing the potential impact and uses of these technologies in everyday life. Awareness in the digital age has expanded to include knowledge of digital tools, cyber security risks and technological advancements such as artificial intelligence and blotching. Individual organizations are increasingly expected to understand how technology affects their personal, business and societal lives (Fry & Lenhart, 2018).

A lecturer is an academic instructor primarily responsible for delivering lectures, facilitating learning, and supporting students' academic progress at a higher education institution. Lecturers engage in activities such as preparing and delivering lectures, assessing student performance, and often contributing to curriculum development (Gosling & Moon, 2001). Their role may vary depending on institutional requirements but typically focuses on fostering a

conducive learning environment and facilitating students' comprehension and knowledge acquisition.

Perceived usefulness refers to the degree to which users believe that Artificial Intelligence (AI) technology will improve their educational tasks, enhance teaching and learning processes and lead to better performance. Davis, (2018). This concept originally derived from Davi's Technology Acceptance Model (TAM) is crucial in understanding how educators and students assess the impact of AI-based tools on educational efficiency and effectiveness. Artificial Intelligence (AI) platforms are perceived as useful when they streamline the learning process by offering personalized learning experiences and automating routine tasks like grading, thus saving time for both students and teachers (Tondeur et al, 2020).

AI is the simulation of human intelligence in machine or computer systems that are designed to perform tasks that typically require human cognitive function, such as learning, reasoning, problem-solving, understanding language and decision-making. AI systems can analyze large amounts of data, recognize patterns and make predictions or actions based on that data, often improving over time through a process known as machine learning. AI enables machines to mimic or replicate aspects of human thought and behaviours, often improving their performance over time through machine learning algorithms (Rusell & Norvig, 2021).

Perceived ease of use has to do with the degree to which an individual believes that using a particular technology will be free from effort. The context of AI's perceived ease of use relates to how simple and intuitive users such as teachers and students find the platform to operate. It is a core concept derived from Davi's Technology Acceptance Model (TAM) which suggests that technologies that are easier to use are more likely to be accepted and adopted. Perceived as ease to use teachers may view an AI tool as easier to use if they can start using it effectively with a minimal tutorial or technical support as opposed to a platform that requires extensive training sessions (Sharman et al, 2021).

Statement of Problem

Teaching and learning have gone beyond teachers standing in front of a group of students and disseminating information to them without the students' adequate participation (Ajayi 2008). This conventional method still survives in academia because it is cheap and efficient.

Unfortunately, it does not adequately develop learners' cognitive ability. They instead remain more passive in the classroom. In the conventional teaching method, students are dependent on the instructors in every instructional-related activity. Such dependence supersedes students' creativity so many of them never get to know their strengths. Part of the disadvantages of the conventional teaching method are over crowd of students in classrooms which leads to low academic performance of students. In this method, a teacher stands in the classroom, faces and explains the contents of the lecture to a large number of students by using chalk/marker and board.

It appears that tools such as Skype, WhatsApp, Google Classroom, Moodle, Edmodo, Schoolboy, Dig and Nin are available and accessible for the teaching and learning process online. The use of these tools according to Ajayi (2008), involves various methods such as systemized feedback systems, computer-based operation networks, video conferencing and audio conferencing, internet/worldwide websites and computer-assisted instruction. However, effective utilization of such innovative teaching tools and methods depends on the lecturer's perceived use.

The usability of innovative technology tools in teaching is lagging behind expectations and desires in Nigerian colleges of education. Tools used in retrieving, storing and sharing information or instructional content should be made accessible to lecturers to ease instruction and have a positive impact on students' academic performance. In this information era, e-learning has become the knowledge provider. Knowledge is disseminated and is made available to many seekers via information technology advanced in social media tools and software facilities, communication and networking systems (Penick & Bonnseter, 2006). With the idea to appeal to the mind through visual and auditory sense organs, educators of all ages seek to utilize audio, visual and audio-visual equipment and materials for teaching and learning. Osuji (2004), noted that the growth in the use of technology has brought outstanding development into modern education. Osuji further noted that media serve as channels through which messages, information, ideas and knowledge are disseminated.

There is a need for a shift from a teachers-centred to learners-centred approach using innovative teaching strategies. Artificial intelligence platforms are among the innovative advanced learning tools that explore learners' creativity, and strengths and are actively involved in constructing knowledge. Artificial intelligence is one of the top

educational networking platforms promoting the quality of innovation, creativity, active contribution and partnership (Rusell & Norvig, 2021). With the above information, there is a need to study the lecturers' perception on the use of Artificial Intelligence platform for teaching Education courses in Colleges of Education in Yobe State, Nigeria.

Objectives of the Study

The main objective of this study is to assess the lecture's perceived use of artificial intelligence (AI) platform for teaching in Colleges of Education in Yobe State. Specifically, the study seeks to determine:

I. Lecturers' perceived usefulness on the use of artificial intelligence platforms for teaching in Colleges of Education in Yobe state.
II. Lecturers' perceived ease of use of artificial intelligence platforms for teaching in Colleges of Education in Yobe State.

Research Questions

The following research questions were raised to guide the study:

I. What is the level of lecturers' perceived usefulness of artificial intelligence platforms for teaching in Colleges of Education in Yobe State?

II. What is the level of lecturers' perceived ease of use of artificial intelligence platforms for teaching in Colleges of Education in Yobe State?

Methodology

The research adopted a survey design. Alamu & Olukosi (2008), say that survey research deals with the collection of data to describe and interpret existing conditions, prevailing practices, beliefs, attitudes and ongoing processes. The population of this study comprises all lecturers from colleges of education in Yobe State. The target population consists of lecturers from schools of Education. Lecturers spread across the schools in the colleges consisted of 146. FCE POT. 74, CAI POT has 11 and USCOE GSH has 61 lecturers. A sample was drawn from the population from three Colleges of Education in Yobe State. 121 lecturers formed the sample of the study from three colleges of education. A simple random sampling technique was used in the selection of the respondents. Krejcie & Morgan (1970) table for sample size was adopted. The instrument used for data collection was

a questionnaire tagged “Perceived Lecturers’ Usefulness and, Ease of Use Artificial Intelligence Platform for Teaching and Learning in Colleges of Education (PLUEAIPL).

The questionnaire contained two sections; Section A requires the respondents’ demographic information, while Section B is subdivided into two sub-sections. Sub-sections one and two contained 10 statement items each on lecturers’ perceived usefulness and perceived ease of use of artificial intelligence for teaching and learning. It adopted four Point Likert scales which the respondents choose from the options provided. Strongly Agree (SA) = 4, Agree (A) = 3, Strongly Disagree (SD) = 2 and Disagree (DA) = 1. The instrument was validated by three lecturers from the Department of Educational Foundations and Curriculum and three Lecturers from the Department of Education Psychology Ahmadu Bello University Zaria, each of them not below the rank of senior lecturer. All corrections, grammatical and spelling errors, and recommendations made by experts were affected and a final copy of the instrument was produced and subjected to pilot testing. The instrument was pilot-tested to ascertain and ensure its reliability.

The pilot testing was carried out at Sir Kashim Ibrahim College of Education Maiduguri, Borno State. The reliability of the instrument was ascertained using the Cronbach alpha reliability coefficient. The result of the pilot testing indicates that the perceived usefulness is 0.593 and, the perceived ease of use is 0.727 respectively. The data was analyzed using descriptive and inferential statistics. Both research questions were answered using mean score and standard deviation, where a mean score cut off of 2.5 was considered agreed while a mean score of 2.4 and below was considered not agreed concerning the research question. All analyses were tested using a statistical package for social sciences (SPSS) Version 23.

Results

Analysis of Demographic Data

Table 1: Distribution of Lecturers Based on Years of Experience

Years of Experience	Frequency	Percentage
1-15	71	59.5
16-30	36	29.8
31- above	13	10.7
Total	**121**	**100.0**

Table 1 shows that 71 lecturers which represent 59.5% of the respondents are within 1-15 years of experience, while 36 lecturers

representing 29.8% of respondents are within 16-30 years of experience and 13 lecturers representing 10.7% are within 31- Above years of experience. The result indicates that lecturers that are within 1-15 years of experience are the majority of the respondents compared to those having 16-30 years of experience and 31-above years of experience.

Table 2: Distribution of Lecturers Based on Colleges

Colleges	**Frequency**	**Percentage**
F C E Potiskum	52	43.0
C O A I Potiskum	10	8.3
C O E Gashua	59	48.8
Total	**121**	**100.0**

From table 3, it indicates that fifty-two of the lecturers which represent 43.0% are from FCE, ten lecturers represent 8.3%are from COAI while fifty-nine which represent 48.8% are from COE which shows that most of the respondents are from COE Gashua, followed by FCE Potiskum and COAI Potiskum.

Research Question One: What is the levels of lecturers' perceived usefulness of artificial intelligence platforms for teaching in Colleges of Education in Yobe State?

Table 3: Mean and standard Deviation of respondents on the Lecturers' perceived usefulness of artificial intelligence platform for Teaching in Colleges of Education in Yobe State.

S/No	**Items**	**Mean**	**SD**	**Decision**
1	Using an Artificial intelligence platform will enhance my effectiveness in my teaching career.	3.42	0.80	Agree
2	The use of an Artificial intelligence platform gives me more control and freedom to facilitate my teaching.	3.34	0.61	Agree
3	Artificial intelligence platforms support the critical part of my tasks.	2.31	1.01	Disagree
4	The use of Artificial intelligence platforms in teaching will make my lessons more diverse.	2.90	1.02	Agree
5	Artificial intelligence platform usage will increase my daily productivity.	3.26	0.98	Agree
6	The use of an Artificial intelligence platform will be counter-productive due to insufficient technical resources.	2.83	0.89	Agree
7	Artificial intelligence platform usage will reduce the stress and tension inherent in teaching large classes.	3.81	0.45	Agree
8	Artificial intelligence platforms will eliminate eye contact and reduce students' seriousness.	3.46	0.91	Agree
9	Artificial intelligence platforms will help me finish the content of my lesson quickly.	2.61	1.01	Agree

10	The teaching-learning process will become easier with the use of Artificial intelligence platforms.	3.12	0.84	Agree
	Cumulative Mean 3.11			

Decision Mean 2.50

Table 3 reveals the responses of the respondents on the lecturers' perceived usefulness of artificial intelligence platforms for teaching in colleges of Education. It shows that the majority of the respondents agree that lecturers perceived that artificial intelligence is useful for teaching, while some of the respondents disagree that artificial intelligence is useful for teaching. The cumulative mean is 3.11, which is greater than the decision mean of 2.50. This implies that lecturers agree on the perceived usefulness of artificial intelligence platforms for teaching.

Research Question two: What is the levels of lecturers' perceived ease of use of artificial intelligence platforms for teaching in Colleges of Education in Yobe State?

Table 4: Mean and standard Deviation on Lecturers' perceived Ease of use of Artificial Intelligence Platform for Teaching in Colleges of Education Yobe State, Nigeria

S/No	Statement	Mean	SD	Decision
1	The use of Artificial intelligence platforms will make my lesson easy.	2.51	0.94	Agree
2	Using an Artificial intelligence platform to teach will be frustrating.	1.68	0.97	Disagree
3	The use of Artificial intelligence platforms will take more of my time than necessary.	2.35	1.12	Disagree
4	Using Artificial intelligent platforms is effortless.	3.04	0.84	Agree
5	Network problems will hinder lessons using the Artificial intelligence platform	3.55	0.83	Agree
6	I can use Artificial intelligence platforms in teaching without written instruction.	2.98	0.80	Agree
7	Artificial intelligence platform usage is always cumbersome.	2.50	1.20	Agree
8	Artificial intelligent platforms are easy to navigate	3.12	1.07	Agree
9	It is easy to become skilful at using Artificial intelligent platform in teaching.	3.38	0.70	Agree
10	Artificial intelligence platform utilization in teaching will be too complex.	2.82	1.18	Agree
	Cumulative Mean 2.79			

Decision Mean 2.50

Table 4 reveals responses of respondents on the lecturers' perceived ease of use of artificial intelligence platforms for teaching education in Colleges of Education in Yobe State. It reveals that majority of the respondents agree that the use of Artificial intelligence platforms for teaching education is easy, while some of the respondents disagree that the use of Artificial intelligence platforms for teaching is easy. This is because the cumulative mean score is 2.79 which is greater than the decision mean of 2.50. This implies that lecturers agree on the perceived ease of use of artificial intelligence platforms for teaching in colleges of education.

Discussion

From the findings of this study, it was deduced that lecturers affirmed the perceived usefulness, and ease of use and have positive perceptions towards the use of artificial intelligence for teaching at colleges of education. Which in line with Zawacki-Richt et al, (2019) Findings suggest that lecturers generally view AI as beneficial for automating administrative tasks, providing individualized support, and enhancing student engagement. Educators valued AI for reducing workload and enabling a more personalized learning experience, though concerns over implementation and accessibility were noted.

Also, the finding is in line with Teo (2011) who indicated that lecturers were more likely to adopt AI when they perceived it as easy to use. The study highlighted that user-friendly interfaces and training support played crucial roles in influencing ease-of-use perceptions among college lecturers.

On perceived ease of use, the findings reveal that lecturers have seen use of AI as a positive way of imparting knowledge which is not in line with Salem & Abu-Naser (2019), whose result shows that lack of technical skills negatively impacted perceptions of ease of use of AI for teaching. The study underscored those lecturers who received adequate training found AI applications more intuitive, suggesting a strong link between technical support and ease of use in educational settings. On the other hand, findings of the current study is in agreement with that of Huang & Hsiao (2012) indicated that lecturers who frequently used AI for administrative tasks reported a higher perception of ease of use for teaching purposes as well. The study also suggested that familiarity with similar digital tools contributed to the perception that AI was manageable and user-friendly.

Recommendations

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

I. The government should provide all facilities and funds for Lecturers to utilize artificial intelligence platforms effectively.

II. The School Authority should organize regular seminars/workshops for college lecturers to be more use of artificial intelligence platforms for teaching in Colleges of Education.

III. Service providers should reduce internet service tariffs so that lecturers and students can afford and use internet services easily.

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Rima International Journal of Education (RIJE), Vol. 3 (No. 3): Nov 2024; page: 77-89 ISSN: 2756 - 6749

The Role of Mathematical Modeling in Enhancing 200 Level Student Understanding of Real Analysis in Federal College of Education Pankshin, Plateau State, Nigeria

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Abstract

This study investigates the proficiency of 200-level students at Federal College of Education, Pankshin, in understanding and applying Real Analysis concepts, the contribution of mathematical modeling to their learning, and the main challenges they face in the process. Using descriptive statistics to analyze responses from 54 students, the findings indicate a reasonable proficiency in Real Analysis, with a grand mean of 3.01624. Mathematical modeling was found to significantly enhance understanding and application, evidenced by a grand mean of 3.02456. However, notable challenges were identified, including the fast pace of the course (Mean = 3.4123) and insufficient seeking of additional help outside of class (Mean = 1.7039), resulting in a grand mean of 2.82936 for challenges faced. While course materials and assessment methods were deemed supportive and effective, the lack of frequent peer discussions on mathematical models was evident. The study concludes that while students demonstrate a fair grasp of Real Analysis, addressing the identified challenges through targeted interventions—such as adjusting course pacing, enhancing support resources, promoting peer discussions, and encouraging the use of additional help—can further improve their learning experience and outcomes. Recommendations include modifying the course pace, fostering collaborative learning, and increasing access to additional support resources. These measures aim to bolster students' comprehension and application of Real Analysis principles, ultimately leading to better academic performance and deeper mathematical understanding.

Key Words: Mathematical Modeling, Real Analysis, Student Understanding, Enhancement and Academic performance

Introduction

Mathematical modeling has emerged as a pivotal factor in contemporary education, significantly contributing to the improvement of students' understanding of complex concepts. This approach enables learners to bridge the gap between abstract

mathematical theories and real-world applications, making learning more relevant and engaging. Salha and Qatanani (2021) emphasize that mathematical modeling not only enhances problem-solving abilities but also deepens conceptual understanding by allowing students to apply mathematical principles to real-world scenarios. At the Federal College of Education, Pankshin, Plateau State, Nigeria, efforts are underway to integrate mathematical modeling into the curriculum for 200-level students enrolled in Real Analysis courses. This integration is seen as a strategic tool to enhance student comprehension and foster skills that go beyond rote memorization, encouraging deeper engagement with mathematical concepts.

The traditional method of teaching mathematics, which often focuses on rote learning and memorization, has long been criticized for producing students with a superficial grasp of mathematical concepts. Nilimaa (2023) asserts that such methods fail to cultivate critical thinking and analytical skills, which are essential for problem-solving in both academic and professional contexts. In contrast, mathematical modeling offers an interactive and applied approach, encouraging students to engage with the material on a deeper level. This method enables students to see the relevance of mathematics in everyday life and across various professional fields. At the Federal College of Education, Pankshin, there is a growing recognition of the need to shift from traditional teaching methods to more dynamic and interactive ones, such as mathematical modeling, to improve student learning outcomes and prepare them for future academic challenges.

The importance of mathematical modeling in education cannot be overstated, as it plays a crucial role in developing a comprehensive understanding of mathematical concepts. By allowing students to visualize, manipulate, and apply these concepts in various contexts, mathematical modeling offers a hands-on experience that is essential for 200-level students preparing for advanced studies. As noted by Bikić, Burgić, and Kurtić (2021), this practical application helps bridge the gap between theoretical knowledge and real-world applications, equipping students with the skills they need for professional careers. Within the context of the Federal College of Education, Pankshin, the integration of mathematical modeling is regarded as a critical step toward enhancing the overall quality of education. This innovative approach is expected to improve student performance, particularly in subjects like Real Analysis, which are foundational for higher-level mathematical studies.

Despite its benefits, the implementation of mathematical modeling in the classroom comes with its own set of challenges. It requires not only highly qualified teachers who are proficient in both mathematical theory and its practical applications but also adequate resources and support systems to ensure the successful adoption of this teaching method. Gastón and Lawrence (2015) highlight that institutions must invest in training educators and providing the necessary tools and infrastructure to facilitate the effective use of mathematical modeling. At the Federal College of Education, Pankshin, efforts are being made to address these challenges by offering professional development opportunities for educators and upgrading classroom resources to support the integration of mathematical models. These initiatives are critical to ensuring that students can fully benefit from this innovative educational strategy.

As the role of mathematical modeling in enhancing student understanding continues to gain recognition at the Federal College of Education, Pankshin, the institution remains committed to refining its approach to teaching abstract mathematical concepts. By providing students with a practical framework for applying theoretical knowledge, mathematical modeling helps develop critical thinking, problem-solving skills, and a deeper appreciation for mathematics. Wang et al. (2023) argue that such skills are vital for academic success and future professional opportunities. As Pankshin continues to integrate mathematical modeling into its curriculum, particularly for 200-level students, it is expected that these learners will achieve a more comprehensive and lasting understanding of mathematics. This approach will better equip them to face both academic challenges and the demands of an increasingly complex world.

The integration of mathematical modeling at the Federal College of Education, Pankshin, represents a forward-thinking shift in mathematics education. This approach promises to enhance the learning experience for 200-level students by fostering a deeper understanding of abstract concepts and improving their problem-solving abilities. As the institution continues to develop its curriculum and support systems, it is anticipated that mathematical modeling will become a central component of its educational strategy, preparing students for success in both their academic pursuits and professional lives.

Statement of Problem

In the field of mathematics education, there exists a significant gap between theoretical understanding and practical application, particularly at the 200-level of study in Real Analysis. Many students struggle with grasping complex concepts, often relying on rote memorization rather than developing a deep comprehension of mathematical principles. This challenge is prevalent at the Federal College of Education, Pankshin, where traditional teaching methods have dominated the curriculum, resulting in a superficial understanding of mathematics among students. The lack of effective pedagogical strategies that emphasize critical thinking and application further exacerbates this issue.

Despite the recognized importance of mathematical modeling as a pedagogical tool, its integration into the curriculum has not been systematically explored within this context. The ideal scenario would involve a curriculum that actively incorporates mathematical modeling to enhance student engagement and understanding. However, the current reality at the Federal College of Education, Pankshin, reveals that 200-level students in Real Analysis continue to face difficulties in relating mathematical theories to real-world applications, leading to a disconnect between their academic performance and the skills necessary for professional success.

The consequences of this gap in understanding are multifaceted. Students may struggle to perform adequately in advanced mathematical courses, limiting their academic and professional opportunities. Furthermore, the inability to apply mathematical concepts to practical situations hinders the development of essential skills, such as critical thinking and problem-solving. This situation calls for a comprehensive investigation into the role of mathematical modeling in enhancing student understanding and academic performance in Real Analysis at the Federal College of Education, Pankshin.

By addressing this issue, the study aims to identify effective strategies for integrating mathematical modeling into the curriculum, ultimately fostering a deeper comprehension of Real Analysis among 200-level students. This will not only improve educational outcomes but also better prepare students for future academic challenges and career paths in mathematics and related fields.

Objectives of the Study

The purpose of this study is to investigate the role of mathematical modeling in enhancing the understanding of 200 level students in Real Analysis at Federal College of Education Pankshin, Plateau State, Nigeria. The specific objectives of the study are:

I. To assess the current level of understanding of Real Analysis among 200-level students of Federal College of Education Pankshin.

II. To explore the effectiveness of mathematical modeling in enhancing students' comprehension of Real Analysis concepts.

III. To identify the challenges faced by 200 level students in learning Real Analysis.

Research Questions

The following research questions were raised to guide the study:

I. How proficient are 200-level students at Federal College of Education, Pankshin, Plateau State, in understanding Real Analysis concepts?

II. How does mathematical modeling contribute to 200 level students' understanding and application of Real Analysis principles?

III. What are the main challenges that 200 level students face in learning Real Analysis?

Methodology

In this study design, surveys are used as a tool by researchers to gain a greater understanding about individual or group perspectives relative to a particular concept or topic of interest. This survey research design provides a structured approach to investigate the role of mathematical modeling in enhancing the understanding of Real Analysis among 200-level students at Federal College of Education Pankshin. Adjustments can be made based on specific institutional requirements and available resources. Surveys provide researchers with reliable, usable, primary data to inform business decisions. They are important because the data comes directly from the individuals you have identified in your goal. And surveys give you a detailed, systematic way to view and analyze your data.

The population for this study consists of 200-level students enrolled in the Mathematics Degree program at Federal College of Education Pankshin. Specifically, there are sixty Two (62) students who are currently enrolled in Real Analysis courses at Federal College of Education Pankshin in 2023/2024 academic session.

The sample will be drawn from the population to represent a diverse group of students. The selection will aim to capture a broad spectrum of student characteristics and experiences to ensure the findings are representative of the population. Given the small population size of 62 students, you can use a sample size calculation method suitable for small populations. One commonly used method for determining sample size in such cases is the Krejcie and Morgan (1970) formula. Here's the Krejcie and Morgan formula for reference: $S = \frac{N}{1+N.e^2}$

Where:

- N is the population size (62 students).
- e is the margin of error (e.g., 0.05 for ±5% accuracy).

Therefore, a sample size of 54 students would be appropriate for your study, considering the small population size of 62 students. This sample size ensures that your study will be statistically significant and provide accurate results.

Results

Research Question 1: How proficient are 200-level students at Federal College of Education, Pankshin, Plateau State, in understanding Real Analysis concepts?

Table 1: The descriptive statistics for the proficiency of 200-level students in understanding Real Analysis concepts based on the provided items.

S/N	ITEAMS	N	MEAN	ST. DEV	REMARK
1	how confident are you in your understanding of the foundational concepts of Real Analysis?	54	3.3882	1.0465	Accept
2	How well do you feel you understand the key principles of Real Analysis?	54	3.2829	0.82076	Accept
3	How effective do you find the current teaching methods in helping you understand Real Analysis concepts?	54	2.8136	0.83489	Accept
4	To what extent do you think you are able to apply Real Analysis principles to solve problems?	54	2.8311	0.99228	Accept
5	How often do you discuss Real Analysis concepts with your peers outside of class?	54	2.7654	1.04186	Accept

Grand Mean= 3.01624

Decision Rule 2.50

Descriptive statistics in table 1 above showed the result of data used to assess the current level of understanding of Real Analysis among 200-level students of Federal College of Education Pankshin. Item 1 have the mean of 3.3882, with the Standard Deviation of 1.0465. Item 2 has mean of 3.2829, with the Standard Deviation of 0.82076.Item 3 have the mean of 2.8136with the Standard Deviation of 0.83489. Item 4 has mean of 2.8311, with the Standard Deviation of 0.99228, Item 5 has mean of 2.7654, with the Standard Deviation of 1.04186. The despondence agreed with item 1,2,3, 4 and 5. The Grand Mean of item 1.2,3,4 and 5 is 3.01624 which are above the Decision Rule (2.50). Therefore we conclude that the analysis of data collected indicates that the 200-level students at Federal College of Education, Pankshin, generally feel proficient in understanding Real Analysis concepts. They are confident in their foundational knowledge, understand key principles, find the teaching methods moderately effective, can apply principles to problem-solving, and discuss these concepts with their peers. This positive perception suggests that the students are reasonably proficient in Real Analysis at their current academic level. The Result is in agreement with work of **Weber (2001)**, who has done extensive work on students' understanding of abstract mathematical concepts and proof-based mathematics courses like Real Analysis. Weber emphasizes that understanding how to approach a proof requires more than knowing mathematical content; students must develop strategies to guide their proof-writing processes. This includes recognizing what techniques are appropriate and how to plan a proof.

Research Question 2: How does mathematical modeling contribute to 200-level students' understanding and application of Real Analysis principles?

The table 2: Contribution of mathematical modeling to students' understanding and application of Real Analysis principles based on the provided items.

S/N	ITEAMS	N	MEAN	ST. DEV	REMARK
6	To what extent do you believe mathematical modeling enhances your understanding of Real Analysis principles?	54	2.9886	0.96736	Accepted
7	How often do you engage in mathematical modeling activities related to Real Analysis in your coursework?	54	3.5921	0.8518	Accepted
8	How well do you think mathematical modeling prepares you to apply Real	54	3.3289	1.06766	Accepted

	Analysis principles in practical situations?				
9	How confident are you in your ability to create mathematical models to solve Real Analysis problems?	54	3.0658	1.11535	Accepted
10	How often do you discuss or share mathematical models with your peers to understand Real Analysis concepts better?	54	2.1474	1.14904	Rejected
				Grand	

Mean= 3.02456

Decision Rule 2.50

Descriptive statistics in table 2 above showed the result of data used to explore the effectiveness of mathematical modeling in enhancing students' comprehension of Real Analysis concepts. Item 6 have the mean of 2.9886, with the Standard Deviation of 0.96736. Item 7 has mean of 3.5921, with the Standard Deviation of 0.8518. Item 8 have the mean of 3.3289 with the Standard Deviation of 1.06766,. Item 9 has mean of 3.0658, with the Standard Deviation of 1.11535, Item 10 has mean 2.9474, with the Standard Deviation of 1.14904. The despondence agreed with item 6,7,8, and 9. But they fail to agree with Item 10. According to their response, they do not discuss or share mathematical models with their peers to understand Real Analysis concepts better. The Grand Mean of item 6,7,8, 9 and 10 is 3.02456 which are above the Decision Rule (2.50). Therefore we conclude that the analysis of the data indicates that mathematical modeling is perceived to significantly contribute to 200-level students' understanding and application of Real Analysis principles. Students believe that mathematical modeling enhances their understanding, they frequently engage in such activities, feel well-prepared for practical applications, and are confident in their ability to create models. However, there is a notable exception regarding the discussion of mathematical models with peers, which is not a common practice among the students. This suggests an area for potential improvement, where encouraging peer discussions about mathematical models could further enhance their understanding of Real Analysis concepts. The result is in agreement with work of Molina-Toro, et al. (2023). Who conducted their research on Digital technologies and their impact on mathematical modeling education: Enhancing understanding and engagement. The study by Molina-Toro, et al. (2023) investigates how digital technologies influence mathematical modeling education. Their research highlights that integrating digital tools in modeling activities significantly enhances students' understanding of complex mathematical concepts and fosters greater engagement. Key findings include: (a)Enhanced

Comprehension and Application: Students who engaged with digital technologies during modeling activities developed a deeper understanding of abstract mathematical concepts and were better able to apply these concepts in real-world scenarios. (b) Increased Engagement and Confidence: The use of digital tools made learning more interactive and engaging, boosting students' confidence in their ability to create and work with mathematical models.(c) Challenges with Peer Collaboration: Despite the benefits, the study noted that students did not frequently discuss or collaborate on mathematical models with their peers. This lack of peer interaction was identified as a potential area for improvement, as discussions and collaborative problem-solving could further enhance learning outcomes.

Research Question 3: What are the main challenges that 200-level students face in learning Real Analysis?

Table 3: the challenges faced by 200-level students in learning Real Analysis based on the provided items.

S/N	ITEAMS	N	MEAN	ST. DEV	REMARK
11	How challenging do you find the pace of the Real Analysis course?	54	3.4123	0.73603	Accepted
12	To what extent do you face difficulties in understanding Real Analysis concepts?	54	2.6754	0.7983	Accepted
13	How well do you think the course materials support your learning of Real Analysis?	54	3.182	0.93749	Accepted
14	How effective do you find the current assessment methods in evaluating your understanding of Real Analysis?	54	3.1732	0.7722	Accepted
15	How often do you seek additional help or resources outside of class to understand Real Analysis concepts?	54	1.7039	1.1378	Rejected

Grand Mean= 2.82936

Decision Rule 2.50

Descriptive statistics in table 3 above showed the result of data used to identify the challenges faced by 200 level students in learning Real Analysis. Item 11 have the mean of 3.4123, with the Standard Deviation of 0.73603. Item 12 has mean of 2.6754, with the Standard Deviation of 0.7983. Item 13 have the mean of 3.182with the Standard Deviation of 0.93749. Item 14 has mean of 3.1732, with the Standard Deviation of 0.7722, Item 15 has mean of 1.7039, with the Standard Deviation of 1.1378. The despondence agreed with item 11,12,13and 14, but they fail to agree with Item 15. According to their response, they do not often seek additional help or resources outside of class to

understand Real Analysis concepts. The analysis of the data indicates that 200-level students at Federal College of Education, Pankshin, face several challenges in learning Real Analysis:

1. **Pace of the Course**: Students find the pace of the Real Analysis course challenging.
2. **Understanding Concepts**: Students experience difficulties in understanding the concepts of Real Analysis.
3. **Course Materials**: Despite the challenges, students feel that the course materials support their learning adequately.
4. **Assessment Methods**: Students find the current assessment methods effective in evaluating their understanding.
5. **Additional Help**: A significant challenge is that students do not frequently seek additional help or resources outside of class, which might hinder their understanding of Real Analysis concepts.

The Grand Mean of item 11,12,13,14 and 15 is 2.82936 which are above the Decision Rule (2.50). The result indicate that while students acknowledge the support from course materials and assessment methods, they still face notable challenges with the pace and understanding of the course, and there is a need to encourage them to seek additional help and resources outside of class to enhance their learning experience. The findings align with studies of **Agarwal et al. (2021)** found that while students often appreciate the resources provided through course materials and assessments, they still encounter difficulties with the speed of the curriculum and comprehension of complex topics. The study emphasized the necessity for institutions to facilitate additional support mechanisms, such as tutoring services and access to supplemental materials, to enhance students' learning experiences.

Discussion

The study revealed that 200-level students at Federal College of Education, Pankshin, generally possess a reasonable proficiency in understanding and applying Real Analysis concepts, with mathematical modeling playing a significant role in enhancing their comprehension and practical application. However, notable challenges were identified, particularly regarding the fast pace of the course and students' reluctance to seek additional help outside of class. While course materials and assessment methods were found to be supportive and effective, peer discussions on mathematical models were infrequent. In conclusion, while students demonstrate a fair

grasp of Real Analysis, addressing the identified challenges through adjustments in course pacing, enhanced support resources, promotion of peer discussions, and encouraging the use of additional help outside of class can further improve their learning experience and outcomes.

Conclusion

the study conclude that, the 200-level students at Federal College of Education, Pankshin, exhibit a reasonable proficiency in understanding and applying Real Analysis concepts, with mathematical modeling significantly contributing to their learning. However, the fast pace of the course and students' reluctance to seek additional help outside of class present notable challenges. While course materials and assessment methods are supportive and effective, there is a need to foster more peer discussions on mathematical models. Addressing these challenges through targeted interventions can further enhance students' comprehension and application of Real Analysis principles, leading to improved academic outcome

Recommendations

Based on the research questions and findings, here are three recommendations:

6. **Adjust the Pace of the Course**: To address the challenge of the fast pace of the Real Analysis course, instructors should consider breaking down complex concepts into smaller, more manageable parts and providing additional time and resources for difficult topics. This approach can help ensure that students are not overwhelmed and can keep up with the course material effectively.
7. **Encourage Peer Discussions and Collaborative Learning**: Since students do not frequently discuss or share mathematical models with their peers, promoting collaborative learning through group assignments, study groups, and peer review sessions can enhance their understanding and application of Real Analysis concepts. Creating a supportive environment for peer discussions can help students learn from each other and deepen their comprehension.
8. **Increase Access to Additional Support and Resources**: Given that students do not often seek additional help outside of class, it is essential to make extra resources more accessible and

encourage their use. Providing tutoring services, extended office hours, online forums, and workshops can offer students the necessary support to overcome difficulties in understanding Real Analysis concepts. Actively promoting these resources can motivate students to take advantage of the help available to them.

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Rima International Journal of Education (RIJE), Vol. 3 (No. 3): Nov 2024; page: 90-99 ISSN: 2756 - 6749

Impact of Online Counseling Platforms on Female Students' Academic Achievement in Tertiary Institutions, Sokoto State

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Abstract

The study is meant to examine the impact of E-learning counseling platform on female students' academic achievement in Sokoto state. Two objectives were set with their corresponding research questions and two hypotheses. The study is quantitative, with a sample size of 301 respondents. The target respondents are the NCE 111 students of Shehu Shagari college of Education, Biga College of Education and Federal College of Education Gidan Madi all in Sokoto state. A stratified random sampling was employed. Structured questionnaires were used for data collection and data analysis was done using partial least squares structural equation modeling (PLS-SEM). The findings of the study revealed that, there is a significant and positive impact of online counseling resource centers on the academic achievement of female students in Sokoto State and also mobile counseling applications have a significant impact on the academic achievement of female students in Sokoto State. Based on the findings, the study recommends the enhancement of Online Counseling Resource Centers, through continuous improvement and expansion of the resources as well as thorough evaluation and Improvement of Mobile Counseling Applications.

Key Words: E-learning, Counseling platform, Academic Achievement and Female Students

Introduction

The integration of Online counseling platform (OCP) in education has gained momentum globally, as it enhances access to educational resources, promotes interactive learning experiences, and develops digital literacy skills (UNESCO, 2013). The academic achievement of students in tertiary institutions is a crucial indicator of their educational success and future prospects (Oguguo, Ajuonuma, Azubuike, Ene, Atta, & Oko, 2020). However, in recent years, online counseling practices (OCP) has become increasingly integrated into educational settings, offering new opportunities for enhancing guidance and counseling practices (Gysbers & Henderson, 2012). Online counseling practices (OCP) offers innovative tools and platforms that can potentially transform the delivery of guidance and counseling services, particularly among female students in tertiary institutions. (Dahiru, 2017).

The integration of Online counseling practices (OCP) in guidance and counseling offers a range of potential benefits for female students. Online counseling resource centers, for example, provide students with easy access to a wide range of counseling materials, self-help resources, and relevant information (Effiom, Amuchi, Ojedor, Ebuka, & Ubi. 2023). By utilizing online counseling resource centers, students can independently explore topics related to their academic success and personal development, ultimately benefiting their academic achievement (Dahiru, 2017). Online counseling resource centers offer a comprehensive collection of resources that cater to students' diverse needs. These centers provide information on various career paths, job market trends, and academic requirements, enabling students to make informed decisions about their educational pathways (Wells, 2023). Moreover, online counseling resource centers offer self-assessment tools that help students identify their strengths, interests, and values, which are essential factors in aligning their academic pursuits with their personal aspirations (Gysbers & Henderson, 2012).

In Sokoto State, like many other regions, there is a growing emphasis on integrating Online counseling practices (OCP) in educational institutions. However, the focus on the guidance and counselling practice to support female students' Online counseling practices (OCP) usage and its impact on their academic achievement remains limited. Female students may face unique challenges and barriers in accessing and utilizing Online counseling practices (OCP) resources effectively. Gender disparities, socio-cultural factors, and limited access to Online counseling practices (OCP) infrastructure and training can hinder their ability to fully benefit from Online counseling practices (OCP) in their academic pursuits.

To address these challenges, the integration of online counseling practices (OCP) in guidance and counseling practice has gained attention as a potential solution. However, the research gap in this study lies in the lack of specific investigation into the educational imperative of different Online counseling practices (OCP) tools on the academic achievement of female students in tertiary institutions in Sokoto State, Nigeria. Existing studies have highlighted the potential benefits of integrating Online counseling practices (OCP) in counseling practice, including online counseling resource centers, mobile applications, E-Learning platforms, and online counseling platforms (Johnson & Rice, 2019). However, these studies have not specifically examined their impact on the academic achievement of female

students in Sokoto State. Therefore, this study aims to address this research gap by focusing on the unique context of Sokoto State and investigating the influence of these specific Online counseling practices (OCP) tools on female students' academic achievement.

Objective of the Study

The objectives of the study is to:

1. To explore the impact of online counseling resource centers on female students' academic achievement in Sokoto State.
2. To evaluate how mobile counseling applications enhance academic achievement among female students in Sokoto State.

Research Questions

In line with this problem, the research tends to answer the following questions

3. What impact do online counseling resource centers have on the academic achievement of female students in Sokoto State?
4. How do mobile counseling applications influence the academic achievement of female Students in Sokoto State?

Hypothesis of the Study

In an attempt to provide answers to the research question stated above, the following hypotheses were tested.

Ho_1: There is no significant relationship between the online counseling resource centers and the academic achievement of female students in Sokoto State.

Ho_2: There is no significant impact of mobile counseling applications on the academic achievement of female students in Sokoto State.

Methodology

This study employed a quantitative research approach using survey research to examine the online counseling practices (OCP) on the academic achievement of female students in tertiary institutions in Sokoto State, Nigeria. The population for this study comprises final year female students from Shehu Shagari College of Education, Biga College of Education, and Federal College of Education Gidan Madi in Sokoto State, Nigeria. The total population of interest consists of

1,215 final year female students. A proportionate sampling technique was employed. This technique involves dividing the population into distinct subgroups or strata based on relevant characteristics, and then selecting participants randomly from each stratum (Gurbuz, 2017).

To determine the sample size, the Taro Yamane formula was employed. By applying the appropriate mathematical approach, the study calculated that a sample size of approximately 301 is necessary. This sample size is deemed sufficient to ensure that the results will accurately reflect the broader population of final year female students. The study administered a total of 331 copies of the research instrument in order to reduce a sampling error, minimize case of non-return of questionnaire and nonresponse bias. This is in line with the study of Israel (1992) as cited by Naing (2003) suggested that 10% or 30% can be added to the sample size to compensate non-return of questionnaire and nonresponse bias. This study adopted 10% increase of the sample size.

Table 1: Sample of the study

S/N	School Name	Level	Population	Sample Size
1	Shehu Shagari College of Education, Sokoto State	NCE III	723	723/1,215 x 301= 179
2	Biga College of Education, Sokoto State	NCE III	412	412/1,215 x 301= 102
3	Gidan Madi Federal College of Education, Sokoto state	400 level	80	80/1,215 x 301= 20
	Total			301
	1,215			

The instrument used for data collection is a structured questionnaire titled "Investigating the impact of online counseling practices and Academic Achievement Questionnaire (OCPAAQ). The questionnaire was administered to the selected samples. The questionnaire includes a close-ended section comprising questions with pre-determined response options. The questionnaire were administered in a classroom setting during a designated time agreed upon with the school authorities.

Results

From the total population of 1,215 final year female students from Shehu Shagari College of Education, Biga College of Education and

Federal College of Education Gida Madi Sokoto State. A sample size of 301 respondents was determined using the Taro Yamane formula, as outlined in chapter three. After adding 10% to the initial sample size, a total of 331 questionnaires were distributed. Out of these, 297 copies of the questionnaire were successfully retrieved and deemed suitable for analysis, resulting in a response rate of 89%. All subsequent analyses were conducted using the 297 valid responses obtained. The demographic profile of the respondents is presented using simple percentages in table 2.

Table 2: Demographic Profile of Respondents

Options	Respondents	Percentage %
Gender		
Female	297	100
Total	**297**	**100%**
Age		
18-24 years	242	81.5
25-34 years	41	13.8
35-44 years	14	4.7
Total	**297**	**100%**
Frequency of ICT Usage		
Daily	0	0
Several Times a Week	5	1.7
Once a Week	7	2.4
Several Times a Month	46	15.5
Rarely	239	80.5
Total	**297**	**100%**

Source: Field survey, 2024.

The demographic profile of the respondents reveals that the study engaged female students, with a total of 297 (100%) participants. The majority of respondents fall within the age of 18 to 20 years. The study also indicates that respondent percentage on the frequent use of online counseling resources is too low.

Test of Hypotheses

Table 3 reports the results of hypothesis testing, presenting path coefficients, t-statistics, p-values, R^2 values, and variance inflation factor (VIF) results. The table provides a detailed account of the findings obtained from the hypothesis testing process.

Table 3: Hypothesis Testing (Path Coefficients)

Variables	**Coefficient**	**T statistics**	**P values**
MAD-> FAA	-0.260	2.350	0.019
OCRC -> FAA	0.335	4.492	0.000
R^2 = 0.963, Adjusted R^2 = 0.963			

Hypothesis One: There is no significant impact between the online counseling resource centers and the academic achievement of female students in Sokoto State.

The findings presented in Table 3. in the hypothesis testing reveal a significant positive impact between online counseling resource centers (OCRC) and female academic achievement (FAA). This is substantiated by the R-squared value of 0.963, indicating a substantial amount of variance explained. The coefficient for the path connecting OCRC and FAA is estimated at 0.335. The t-statistics value associated with this coefficient is 4.492, with a corresponding p-value of 0.000. Given that the p-value (0.000) falls below the predetermined significance level (e.g., $\alpha = 0.05$), the study rejects the null hypothesis (H_{02}) in favor of the alternative hypothesis. These outcomes highlight the significant and positive impact of online counseling resource centers on the academic achievement of female students in Sokoto State.

Hypothesis Two: There is no significant impact of mobile counseling applications on the academic achievement of female students in Sokoto State.

Table 3 results demonstrate a statistically significant negative impact between mobile counseling applications (MAD) and female academic achievement (FAA). This is supported by the high R-squared value of 0.963, indicating that a substantial amount of the variance is explained by the model. The coefficient for the path connecting MAD and FAA is estimated at -0.260. The associated t-statistic for this coefficient is 2.350, and the corresponding p-value is 0.019. These findings indicate that the null hypothesis (H_{O2}) can be rejected in favor of the alternative hypothesis. Therefore, it can be concluded that mobile counseling applications have a significant impact on the academic achievement of female students in Sokoto State, suggesting that as their usage increases, academic performance may decrease.

Discussion

The discussion of the findings is based on the formulated hypotheses and how they are in the study.

There is no significant impact of mobile counseling applications on the academic achievement of female students in Sokoto State. The analysis of the collected data led to significant findings that enhance the understanding of the influence of online counseling practices tools

on academic achievement among female students in Sokoto State. The key findings are as follows:

5. Online Counseling Resource Centers (OCRC) exhibited a significant positive effect on female academic achievement.
6. Mobile Counseling Applications (MAD) demonstrated a significant negative effect on academic achievement.

Conclusion

The primary objective of this study was to explore the influence of online counseling practices on the academic achievement of female students in tertiary institutions in Sokoto State. Specifically, the study investigated the influence of two key factors: online counseling resource centers and mobile counseling applications. Utilizing a quantitative research approach, the study employed Partial Least Squares Structural Equation Modeling (PLS-SEM) to analyze the relationships between these factors and the outcome of academic achievement. The analysis of the data yielded notable and statistically significant findings, which carry practical implications for educators, policymakers, and other relevant stakeholders.

The findings of this study provide valuable insights into the role of online counseling practices on the academic achievement of female students in tertiary institutions in Sokoto State. First, online counseling resource centers were found to have a significant positive effect on academic achievement. This underscores the importance of accessible and effective counseling resources that support students in navigating academic challenges and personal issues.

Second, the analysis revealed a significant negative effect of mobile counseling applications on academic achievement. This unexpected finding suggests the need for a thorough evaluation of the content and usability of these applications, as they may not be effectively meeting the needs of female students. Further research is warranted to understand the factors contributing to this negative impact and to explore ways to improve mobile counseling resources.

Recommendations

Based on the findings, summary, and conclusion of this study, the following recommendations are proposed for educators, policymakers, and stakeholders in Sokoto State:

7. Enhancement of Online Counseling Resource Centers: Given the significant positive effect of online counseling resource centers on academic achievement, it is recommended that institutions invest in the continuous improvement and expansion of these resources. This includes ensuring that the centers are adequately staffed with trained counselors and that they offer a wide range of support services tailored to the needs of female students. Regular assessments of resource effectiveness and student feedback should guide the ongoing development of these centers.
8. Evaluation and Improvement of Mobile Counseling Applications: In light of the unexpected negative impact of mobile counseling applications, a thorough evaluation of these tools is necessary. Developers and educators should collaborate to redesign these applications, focusing on content relevance, user interface, and accessibility. Incorporating user feedback into the development process will help create applications that genuinely support students' academic needs and enhance their learning experiences.

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Rima International Journal of Education (RIJE), Vol. 3 (No. 3): Nov 2024; P: 100-111 | ISSN: 2756 - 6749

Role of Religion in Combating Hook up Practice among the Undergraduate Students in Kwara State: Challenges and Way Forward

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Abstract

All heavenly recognized religions on the earth do not confine their discussions to religious aspects of life and disregard other aspects but they spread their discussions all over including creation of special awareness to the danger associated with un-marital and transactional sex. It is against this background that the study examined the role of religions in curbing hook up practices among undergraduate students in Kwara State, Nigeria. The historical, analytical and phenomenological methods of research were used to do justice to this work. The historical method was used to discuss the historical background of hook up in Kwara State, the analytical approach was used to analyse the role of religions in combating hook up practice among undergraduate students while the phenomenological method was used to determine the trends of hook up in our contemporary society among undergraduate students. The findings of this study revealed that the practice of hook up had a significant negative impact on female life and the religious awareness on the effects of the illicit act is not encouraging. It was concluded in the study that the practice of hook up is a rebranded prostitute that have detrimental effects on female undergraduate students. It is therefore suggested in this study that MSSN and other religious organizations coupled with the support of the government should organize sensitization gatherings, seminars and workshops on the effects of hook up practice on the life of undergraduate female students.

Key Words: Religious scholars, hook up, combating, undergraduate students, Kwara State

Introduction

The act of engaging in illicit intercourse among the young adults for making money has become modern civilization in Nigeria. According to Ayotola, Haruna, Abdussalam, & Abiodun (2020) hook up is the illegal relationship constituted nowadays among undergraduate students and young adults through sending online romantic messages, photos and pictures. Lamentably, this implies that sexing, transactional sex and a host of others are among the common practices among the young adults in Nigerian tertiary institutions. Similarly, hook up is illegal pre-marital consolidation widely practiced among

undergraduate students in Nigerian tertiary institutions via sending raunchy messages, self-naked displaying photos, snapping sexually explicit images and pictures to their proposed clients or customers with the aid of phones (Bolanle, Olayori, & Idowu, 2022).

Furthermore, Wylegly (2019) defined hook up as rebranded prostitution of the early age to suit the demand of current young adults. Wylegly (2019) explained further that the old method of the prostitution and the new share some features which include, frequent change of customers/partners, financial benefits and emotional indifference. Also, Ajayi, (2017) presented hook up practice as the illegal relationship commonly practiced among young adults and it is purposively built on economic buoyancy, social capital and material supports accumulation. Therefore, Oyeoku, Ibezim, Agwu, & Okoye, (2022) noted that the motives surrounding undergraduate students' engagement in this illicit act could be summarized as acquisition of social status, capital improvement, luxury needs, excellent grade and sexual satisfaction.

All prominent religions in Nigeria discourage practicing adultery and fornication and symbolize it as sinful and illegal act that destroy devotees' personality, their families and the entire family. Qur-'ān says:

> "Nor come nigh to adultery: for it is a shameful (deed) and an evil, opening the road (to other evils) (17:32)."

On this note, Imam ibn Katheer (1999) explained that adultery or fornication is a great evil that led people to other forms of evils in the society. Yusuf (2010) similarly, commented that adultery or fornication is not only shameful on itself but it destroys consistency, personality, respect and originality among others in fornicator and adulterer. It showed from the above scholastic commentaries on the nature of adultery or fornication which is rebranded in this modern society to denote "hook up" that participating in it will devalue perpetrators socially, religiously and morally to mention a few.

Furthermore, there are many portions of Bible that condemn this act due to it is ability to endanger not only the adulterer or fornicator but also the children, family and entire society.

Historical Background of Hook up in Nigeria Tertiary Institutions

Historically, hook up is a deceivable word adopted to describe physical sexual activities between sexual partners with the aim of getting financial benefits, social recognition, and sexual satisfaction (Oyeku, et al. 2022). The practice of prostitution which had been in existence among opposite sex in Nigeria for long is now rebranded and metamorphosed to hook up or friend with benefits among undergraduate students in Nigeria. Ajayi (2017) explained that prostitution rebranded has been getting momentum in our tertiary institutions nowadays especially among female gender due to lack of financial support from the parents or guardians. This implies that female undergraduate students in the tertiary institutions in Nigeria had seen this abnormality as alternative for getting livelihood and way of generating funds for their survival and educational attainment.

Bogle (2008) explained that historical evolution of hooking up can be traced to 1960s when dating became permitted tradition among college students. In the same vein, Armstrong et al. (2009) and England et al., (2008) submitted that the trends of rebranded prostitution in Nigeria tertiary institutions had gone beyond controlled. They claimed that this sinful practice became popular around 1980s. It is reliable that hooking up is not a new practice in Nigeria but designing it in another fantastic and captivating ways had ever been taught.

In order to logically and systematically present the evolutionary of hook up among undergraduate students in Nigeria, Heldman and Wade (2010) categorized the practice into oral, anal and vaginal sexes. Oral sex was very common among the young people in Nigeria before 1992 when civilization transformed and destroyed our culture. This type of sex was practiced especially among 18-24 years old before the practice graduated to anal-vaginal sex around 2004 among 18-39 years. Furthermore, Ajayi (2017) submitted that prostitution became rebranded and modernised among undergraduate students particularly during COVID-19 pandemic when many parents lost their job and the life became unpleasant for them. The painful situation of that period pushed the young ladies in the campus to design possible way out for getting satisfaction.

Furthermore, the issue of un-marital sexual intercourse had been practiced in Nigeria for long, especially around 1960 when women began to lose dignity and sense of honour (Oyeoku, 2014). During this period, support for freedom of sex became new ideas and beliefs

among Nigerian women to the level that a single woman would have as many as possible men friends cohabitating her for money and sexual satisfaction. However, it implies from the submission that hookup is not a new practice in Nigeria; the only thing that differentiate prostitution from hookup is modernization. The use of technologies of different types is among the instruments adopted by hookers up in Nigeria.

Introduction and application of different strategies and techniques in to the practice among undergraduate students in Nigeria makes it different from the old fashion. On this note, Heldman and Wade (2010) explained that the old was just sexual satisfaction for benefits not unrealistic dating and immoral causal sexual relationship. Garcial and Reiber (2008) pointed out that during personal observation one third of undergraduate students confirmed that their first time of having intercourse was through hooking up. Heldman and Wade (2010) submitted that the major factors that contributed to the hike in the practice of hooking up among undergraduate students in Nigeria now are:

1. University and College policies
2. Gender distribution of university and college students
3. Poor control of nature and type drugs the students consume
4. Free access to pornographic media
5. Modern design in self-objectification
6. Increase narcissism level in the name of sexual satisfaction
7. Introduction of new phase to marriage norms in Nigeria
8. Development of mixing feelings and perception for sexual risk

Furthermore, Wylegly (2019) stated that the factors responsible for the increase in the numbers of undergraduate students practicing hooking up in Nigeria tertiary institutions can be folded under the following:

9. Biological and physiological factors
    a. A very large disparities between the two genders dwelling in the campus
    b. Unexpected rapid changes in the physical appearance of the two gender
    c. Indecent appearance showcased mostly by female counterpart
10. Environmental and cultural factors
    a. Nature of policies governing university environment
    b. Emulation of bad culture

c. Freedom of navigating your ways as you wish is the order of the campus

11. Economic factors
    a. Difficult financial situation during studies
    b. Parental economic dissatisfaction
12. Capability factors
    a. Laziness in the part of weak students
    b. Means of getting marks from the lecturers
    c. Willingness to take rough path to arrive at the destination

Effects of Hooking up in the life of undergraduate students in Nigeria

Numerous studies had confirmed that danger associated with hookup is more than the benefits. The gravity of regret which undergraduate students nurse after being graduated from the university is enormous. Many of them graduated from the school with series of deadly diseases due to the immoral practice that put them at a very risky of sexually transmitted diseases and not last long relationship (Ajayi et al. 2017). According to Ayotola, et al. (2023) explained that the negative consequences of hooking up can be summed up under the following: indiscriminative urge for sex, development of unrefined attitude towards sex, personal embarrassment, loss of dignity and honour and the host of others. Eke et al. (2022) stated that the consequences of practicing hooking up include: easy access to transmitted diseases, development of emotional trauma especially for a lady who is not willing to undertake it, possibility of having as many as possible partners at hand, it may result to unwanted pregnancy and the host of others.

Hooking up's effect does not limit to transmission of diseases but also extend to disappearance of sexual satisfaction which is likely to be more dangerous. This according to Ayotola et al. (2023) promotes lesbianism, gay, bisexualism and transgender and nowadays the practices are very common among the teenagers.

Roles of Religion in Combating Hooking up Practice among Undergraduate Students in Nigeria

Religion is a significant weapon for shaping individual's life right from the birth till death. Religion should be the monitor and manager of every stage of individual's life in order to gain progress in this life and forgiveness in the next life. Somefun (2019) described religion as a system of belief that usually have varying influences on individual's

behaviour, manners, attitudes and the host of others. According to Waheedullah (2016) religion is a foundation of morality and belief which serves as internal and external forces for controlling individual's life. Eliade (2010) similarly defined religion as a unified system of beliefs and practices that normally brings together people of different tribes. In the same vein, Deton (2006) conceived religion as a sacred relationship between man and God. Similarly, Gallagber and Tierney (2013) presented religion as individual's beliefs, spirituality and his reverence towards the Creator. This implies that application and practicability of religious teachings perfectly and effectively to promote positive changes in life is what is meant by religion. Owojuyigbe and Busari (2014) submitted that religion always influences people's thoughts, ideology and their perspectives.

Osalusi and Alonge (2020) maintained that religious inclination significantly influences university students' values and moral behaviours. Okon (2012) stated that Nigerian society is devaluing and frustrating through poor socialization and culture. Owojuyigbe and Busari (2014) also commented that university environment is expected to be well planned to play vital roles in fostering moral and value education that could prevent undergraduate students from all irrational behaviours.

Significantly, religion promotes individual's dignity and preserves his personality. This submission is similar to the statement of Somefun (2019) that religion makes one survives during hardship and difficult situations without committing atrocities. Harry (2006) also stated that religion strengthens solidarity among people and promotes norms of social system. Wachukwu (2019) also observed that religion is a powerful means of providing responses to individual's hardship and pains and promoting moral values through which humanity prevails and nation develops. Ayotola, et al. (2022) also claimed that religion promotes high moral standard such as honesty, dignity, decency, selflessness, perseverance, obedience and respect. It shows from the above submissions that religion is what that can strengthen moral values and weaken the power of social vices in the society.

Religion is an effective weapon for correcting social vices among the teenagers and youths in Nigeria. According to Somefun (2019), inability to practice religion effectively had contributed to the increase in the numbers of youths and teenagers participating in risky sexual activity and unwanted pregnancy. Owojuyigbe and Busari (2014)

concluded in their study that religion is a power mechanism that can sets difference between deviance and control, chaos and order, dispute and resolution, change and maintenance status quo. Therefore, religion is expected to use as instrument for fighting against social vices, deviance, chaos and a host of others in the society. According Oyeoku (2014), religious practices should be geared towards moral and spiritual development.

Somefun (2019) opined that the process of having strength in religious beliefs and practices is among the major steps for combating transactional sex among the students in Nigeria. The researcher concluded that religiousity is a powerful tool for controlling illicit sexual practices among the students in Nigerian institutions. Comfort et al. (2011) corroborated the view stating that religion organizations in collaboration with policy makers would bring solution to this problem of hook up practice. Wylegly (2019) concluded that many undergraduate students especially female practice hook up due to lack of sex education, poverty and poor religious orientation. In the same vein, Oyeoku, et al. (2022) concluded in their study that lack of moral standard, parental disconnectedness, gender, peer group influence, family poor economic background among others contributed to the hike of hook up practice among undergraduate students in Nigeria.

Heldman and Wade (2010) similarly, concluded that hook up practice is becoming favourable practice among undergraduate students due to inconsistent gender distribution of students, lack of working religion organization, incessant changing in the usage of sex enhancing drugs, consumption of pornography, newly invented marriage norms and to mention a few.

Family poor economic background contributes to the high rate of hook up practice among students in the country. It is pertinent to note that the practice is getting favourable acceptance among undergraduate students majorly because of poor practice of religion and confusing perspectives about the effects of sexual transmitted diseases. Wolfson and Leung (2020) submitted that poor parenting, lack of supervision from the parent and other guidance, mass media and peer pressure are factors that contributed to the curbing of the menace of hook up among the youths.

Factors Hindering Success of Religion in Combating Hook up in Nigeria

Religion is an instrument of change if it is well practiced. Awolalu (2010) explained that religion is capable of promoting high moral, social and spiritual standard of youths across the country. Consistency, respect, obedience, honesty, credibility, and modesty among others would be promoted in the society through proper practice of religion (Wachukwu, 2019). Many factors are attributed to the failure of religion in controlling hook up practice among the youths especially university students in Nigeria which include: poor method of religion propagation, poor implementation of religion policies, lack of good and pious traditional leaders, bad governance and corruption (Wachukwu, 2019).

Poor method of religion evangelism is one of the factors hindering the success of religion in combating hook up in Nigeria. Erinola, Timothy, Edime and Mejiyan (2004) stated that potential extremism, media and communication challenges, inter religious tension as well as credibility and trust issues are some of the factors that hinder the success of the religion in striving against the menace of hook up practices in Nigeria. Amy, Christopher, Terrence and Norval (2009) examined the impact of both individual and institutional religious involvement on "hooking up" in a national sample of college women. The study revealed that women who attend higher institutions with religious affiliations are more into hooking up than those without religious affiliation. This may be attributed to poor method of religion propagation.

Similarly, among those factors that hindered religion from combating hook up practices among the youths in Nigeria is the poor implementation of religious policies. The role of faith leaders in the kicking against hook up can never be underestimated. The positions of some religious bodies are most important factor in determining the position of girls in a variety of activities, including finishing school, marriage and gaining access to health services, but is rarely provided and even discussed (Christian Aid, 2016). Hence, to combat the menace of hook up, the leadership of the various religious bodies in the country such as Christian Association of Nigeria (CAN), Jama'atu Nasril Islam (JNI) and other congregations to intensifying their efforts against hook up practices in the country.

The backlash effects of poor traditional leadership, corruption, bad governance and traditional leaders constitutes a threat to the fight against hook up practices among the youths on campus. The fear of

carry over, poverty, immoralities from the community leaders and poor mentorship and host of others are all common factors hindering the success against hook up practices among undergraduates in Nigeria. It is worthy of note that hook up could lead to illicit sexual intercourse. Asrese and Mekonnen (2018), who asserted that promiscuous sexual behaviours frequently lead to outcomes like unintended pregnancy and STIs. Asyraaf and Badayai (2022) also supported this when he revealed that most students engage in unprotected vaginal, oral, or anal intercourse with consequences such as higher risk of STIs, including HIV and unintended pregnancy.

According to Shittu (2012) typical example of right method for propagating religion was numerously displayed by the Prophet (Peace be upon him) during the propagation of Islam through assisting the needy, feeding the hungry ones, rescuing the losers and giving the less privileged among people living in Madinah. Similar practices were recorded from past scholars from different parts of the state in Nigeria and outside Nigeria. This implied that religious leaders of this period propagate religion with instruments such as exotic cars, beautiful houses, expensive clothes and hypocrisy that will not promote love, peace and unity. Furthermore, Wachukwu (2019) submitted that corruption of higher level has uprooted piety, faith, sincerity, and modesty to mention a few from the lives of Nigerian youths including university students. However, recognizing the inevitable significance of peace, tolerance, justice, charity, selflessness, self-denial, and dignity among others in practicing and propagation of religion will assist both religion and traditional leaders work together to rehabilitate the youths and sensitise them on the effect of hook up on their lives and entire society (Zayed & Harbi, 2020).

Conclusion

It is concluded in this study that the practice of hook up is a rebranded prostitute that have detrimental effects on female undergraduate students.

Suggestion

Based on the submissions stated above, the following are the suggestions that need due attention:

13. Policy makers in collaboration with religion organisations should fight against the practice in the campus

14. Religious scholars in the society should wake up and strategise an effective way out for the reduction of the practice among undergraduate students in Nigeria
15. Parents should priorities moral teaching and sexual education

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Rima International Journal of Education (RIJE), Vol. 3 (No. 3): Nov 2024; P: 112-122 ISSN: 2756 - 6749

Assessment of Counselling Needs of Sickle Cell Anaemia Patients Attending Specialist Hospital Sokoto State

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Abstract

Abstract
The study examined the counselling needs of sickle cell anaemia patients attending specialist hospital in Sokoto Metropolis. The study used cross-sectional survey research design. The population of the study consisted of 3322 sickle cell patient attending Specialist Hospital Sokoto from 2021-2023. Purposively represented by 346 respondents as a sample size. . The instrument used for this study was entitled "Counselling Needs of Patients with Sickle-cell Anaemia Disease Questionnaire (CNPSADQ) with 0.78 and 0.82 validity and reliability indexes respectively. Two research objectives and two research hypotheses were formulated as guide to the study. The data collected were used to test the hypotheses and the results indicated that, there is a significant counselling needs' on the sickle cell anaemia patients attending Specialist hospital in Sokoto Metropolis based on mental health and also revealed that there is significant difference in the effect of counselling needs of sickle cell anaemia patients attending Specialist hospital in Sokoto Metropolis based on gender Finally it was recommended that Counseling programs shall specifically focus to address the unique mental health needs of sickle cell anemia patients and government shall create gender-sensitive counselling interventions that recognize and address the distinct emotional and social support needs of male and female patients.

Key Words: Counselling Needs & Sickle cell Anaemia Patients

Introduction

Sickle cell is a disease of the blood. It is an inherited chronic anaemia that is caused by a decrease in the normal amount of oxygen that is carried by blood due to abnormal haemoglobin. Hassell (2010) explained that sickle cells in blood vessels can result into vaso-occlusion; it is very painful and damaging to the tissues and organs of the body. Also, sickle cell disease (SCD) is an inherited disorder in which the shape of red block cells are C-shaped sickles and can get stuck in blood vessels, thereby blocking the blood vessels. This blockage is known as a pain crisis or sickle crisis. According to Agomoh and Kanu (2015), there are millions of red blood cells, white blood cells and the platelets in the human blood.

The sickle cell sticks together and blocks the movement of oxygen in the tiny vessels in the lungs. In fact, multiple experiences of acute chest syndrome can cause permanent lung damage. In addition, sickle cell can damage an organ that fights infection i.e. (spleen), leaving the patients more vulnerable to infections. Sickle cell anaemia is caused by mutation in the gene that allows the body to make red blood cell (iron-rich compound that gives blood its red colour called haemoglobin) (Obi, 2018).

When afflicted with sickle cell anaemia, the patients' abnormal haemoglobin causes red blood cells to become rigid, sticking and deformed. The sickle cell gene is transferred from generation to generation in a pattern of inheritance that is called autosomal recessive inheritance. This means that both the mother and the father must transfer on the defective form of the gene for a child to be affected. There are series of health challenges associated with sickle cell anaemia.

Adolescents with sickle cell anaemia may have several counselling needs. The counselling needs of adolescents with sickle cell anaemia may include counselling on self-concept medical care, communication, awareness of the symptoms of sickle cell anaemia, knowledge of the medical services available for the disease (Adegboyega, 2020). Udoh (2017) identified the counselling needs of people with sickle cell anaemia. He listed some of them as new for effective communication, self-understanding and medical care. Nwanju (2018) identified such needs as need for positive self-concept and self-acceptance as well as need for special attention by teachers. According to WHO (2017), the presence of this abnormal state causes vasooclusion and anaemia and may cause damage to major organs in the body when not treated. In a recent report by United Globally, 5% of the world population have genetic traits of haemoglobin disorders largely sickle cell disease and thalassemia (WHO 2017). Also, it is estimated that 300,000 babies areborn with severe haemoglobin disorders each year (WHO, 2016). SCD has been discovered to be more prevalent in the USA and UK (Saraf et al. 2014).

Mental health encompasses an individual's emotional, psychological, and social well-being, significantly influencing their thoughts, feelings, and behaviors. It serves as a foundation for how people handle stress, relate to others, and navigate life's challenges. Mental health is not merely the absence of mental disorders, but it includes the presence

of positive characteristics such as emotional resilience, adaptability, and the ability to maintain healthy relationships (World Health Organization [WHO], 2022).Several factors shape an individual's mental health, including genetic predispositions, environmental conditions, and life experiences. Research highlights that mental health is deeply intertwined with both biological and environmental influences.

Gender differences can play a role in the manifestation and experience of sickle cell crises, a defining characteristic of sickle cell anaemia. While sickle cell anaemia affects both males and females, certain aspects of the condition may vary between genders. Studies suggest that males with sickle cell anaemia may experience more frequent and severe sickle cell crises compared to females (Platt et al., 2018). The reasons for this difference are not entirely clear but could be related to hormonal influences or genetic factors. Hormones, particularly estrogen, may have a protective effect in females (Cegile et al., 2019). Estrogen has been proposed to have a positive impact on the red blood cell and may help mitigate some of the complications associated with sickle cell anaemia. This hormonal influence may contribute to the observed gender differences in the frequency and severity of crises.

Udoh (2017) observed that there is no significant difference between the counselling needs of adolescents with sickle cell anaemia based on gender. Hassell (2010) however, observed differences between the counselling needs of adolescents with sickle cell anaemia based on parental education and parental socio-economic background. On the other hand, Nwanju (2018) observed that there is no significant difference between adolescents with sickle cell anaemia from broken and intact families. This study contributes in the literature on the counselling needs of sickle cell anaemia patients attending public hospitals outside of Sokoto metropolis on the bases of four variables - their mental health, gender, marital status, and religious beliefs, it is against the backdrop that the study investigate the counselling needs of sickle cell anaemia patientss attending government hospital in Sokoto Metropolis.

Objectives of the Study

1. Examine the counselling needs of sickle cell anaemia patients, attending Specialist hospital in Sokoto metropolis, based on their mental health.

2. Examine the counselling needs of sickle cell anaemia patients, attending Specialist hospital in Sokoto metropolis, based on their gender differences.

Research Hypotheses

H_{01}: There is no significant difference in the effect of counselling needs of sickle cell anaemia patients attending Specialist hospital in Sokoto metropolis based on their mental health.

H_{02}: There is no significant different in the effect of counselling needs of sickle cell anaemia patients attending Specialist hospital in Sokoto Metropolis based on their gender differences.

Methodology

The study adopted a cross-sectional survey research design. The population of the study comprises all sickle cell Anaemia patients attending Specialist Hospital Sokoto from 2021-2023

According to record from Specialist Hospital Sokoto there are three thousand three hundred and twenty two (3322) sickle cell anaemia patients.

Table 1: Population of Sickle cell Aneamia Patients Attending Specialist Hospital Sokoto from 2021 to 20203

YEAR	2021			2022			2023		
MONTH	M	F	TOTAL	M	F	TOTAL	M	F	TOTAL
January	16	45	61	38	96	134	77	47	124
February	34	63	97	37	20	57	12	10	22
March	47	22	69	33	27	60	-	-	-
April	29	09	38	31	42	73	14	19	33
May	22	19	41	13	18	31	20	27	47
June	-	-		26	13	39	22	06	28
July	10	65	75	107	91	198	20	17	37
August	48	64	112	14	16	30	47	34	81
September	37	31	58	40	25	65	14	17	31
October	14	44	58	47	61	108	61	83	144
November	109	110	219	124	139	263	19	17	36
December	50	99	149	371	296	667	10	17	27
Total	416	571	987	881	844	1725	316	294	610

Source: Specialist Hospital (2024)

Purposive sampling was used to select Specialist Hospital Sokoto as an area of study because it satisfy the specific needs of the researcher since it is the only general Hospital providing easy access to target respondents. The research adviser (2006), table was used to determine the sample size from a given population, and arrived at three hundred and forty six (346) participants of the study.

Table 2: Sample size of the population of sickle anaemia patients attending Specialist Hospital

S/NO	YEAR	M	F	TOTAL
1	2021	416	571	987
2	2022	881	844	1725
3	2023	316	294	610
	GRAND TOTAL			**3322**

Field Survey (2024)

The questionnaire tagged 'Counselling Needs of Patients with Sickle-cell Anaemia Disease Questionnaire (CNPSADQ) was used. After scrutiny, some items were dropped and some were added and its was concluded that the instrument has construct and content validity with validity index of 0.82 and reliability index of 0.78. The completed questionnaires were retrieved from the patients and subjected to data analysis using independent t-test and ANOVA to test significance level at 0.05.

Tests for Hypotheses

HO_1: There is no significant difference in the effect of counselling needs of sickle cell anaemia patients attending Specialist hospital in Sokoto metropolis based on their mental health.

Table 6: ANOVA result comparing the difference in the effect of counselling needs of sickle cell anaemia patients attending Specialist hospital in Sokoto metropolis based on their mental health.

Source of Variation	Sum of squares	Df	Mean square	F	P-value	Decision
Between Groups	0.118	3	496.086	0.054	.000	$H0_1$: Rejected
Within Groups	308.582	332	9.999			
Total	**308.640**	**335**				

Source: Field Work, 2024

$\propto = 0.05$

Table 6 shows the ANOVA result comparing counseling needs among sickle cell anemia patients at the Specialist Hospital in Sokoto metropolis, based on mental health, shows a p-value of 0.000, which is lower than the alpha level of 0.05 ($p < 0.05$). This outcome leads to the rejection of the null hypothesis, indicating a significant difference in the counseling needs' impact on the mental health of these patients.

HO_2: There is no significant different in the effect of counselling needs of sickle cell anaemia patients attending Specialist hospital in Sokoto Metropolis based on their gender differences.

Table 7: t-test result comparing the difference in the effect of counselling needs of sickle cell anaemia patients attending Specialist hospital in Sokoto Metropolis based on their gender differences.

Source of Variation	N	Mean	Std. Deviation	t-value	P-value	Decision
Male	336	1.66	.474	6.514	.000	$H0_1$: Rejected
Female	336	1.42	.494			
Total	**672**	**2.88**				

Source: Field Work, 2024

Table 6 shows the t-test result comparing the difference in the effect of counselling needs of sickle cell anaemia patients attending Specialist hospital in Sokoto Metropolis based on their gender. From the Table,

the p-value 0.000 is less than the alpha value of 0.05 ($p<0.05$). This indicates that the null hypothesis was rejected. Since the p-value (0.000) is less than the significance level of 0.05, we reject the null hypothesis. This result suggests that there is a statistically significant difference in the counselling needs of male and female sickle cell anemia patients attending Specialist Hospital in Sokoto Metropolis.

The summary of finding shows that:

3. There is significant difference in the effect of counselling needs of sickle cell anaemia patients attending Specialist hospital in Sokoto metropolis based on their mental health.
4. There is significant difference in the effect of counselling needs of sickle cell anaemia patients attending Specialist hospital in Sokoto Metropolis based on their gender differences

Discussions

The result of the hypothesis one which stated that, there is no significant difference in the effect of counselling needs of sickle cell anaemia patients attending Specialist hospital in Sokoto metropolis based on their mental health indicated a significant counselling needs' on the mental health of these patients. This outcome is agreed with the research finding of Puskar and Bernardo (2020), which posited that counseling interventions can effectively improve mental health by addressing the unique psychological stressors that chronic illness patients face. They argue that counseling equips patients with coping mechanisms and resilience strategies that enhance focus, motivation, and overall well-being. Similarly, research by Irwin et al. (2021) underscores that patients with chronic conditions, including sickle-cell anemia, often experience setbacks due to physical and

emotional stress; however, counselling provides a structured support system, fostering a sense of stability that benefits their mental engagement. These scholarly insights validated the present findings, and that counselling services are integral to helping sickle-cell anemia patients to overcome barriers and reach their mental potential

The result of the hypothesis two which stated that there is no significant different in the effect of counselling needs of sickle cell anaemia patients attending Specialist hospital in Sokoto Metropolis based on their gender differences indicated that there is a statistically significant difference in the counselling needs of male and female sickle cell anemia patients attending Specialist Hospital in Sokoto Metropolis. This finding goes in line with, Geronimus and Thompson (2021) who stated that chronic illness patients often face different emotional and social challenges based on gender, and counselling that is attuned to these differences can improve the therapeutic outcome. Additionally, Larson and Dear (2019), find out that male and female patients tend to have different coping mechanisms and support preferences in managing chronic illnesses like sickle-cell anemia. They argue that while female patients may benefit from emotionally expressive counseling sessions, male patients might prefer structured, solution-focused approaches. These insights support the need for tailored counselling interventions that address the specific gender-based needs of sickle-cell anemia patients, thereby enhancing the effectiveness of counseling in improving patient well-being.

Conclusion

In conclusion, the findings highlight the critical need for personalized councelling services that address the diverse needs of sickle cell anemia patients at the Specialist Hospital in Sokoto metropolis. The significant impact of mental health on counseling needs suggests that tailored mental health support is essential for these patients, who may face unique psychological challenges associated with their condition. Furthermore, the marked differences in counselling needs based on gender demonstrate the importance of gender-sensitive counseling strategies, which could help to ensure that both male and female patients receive appropriate and effective support.

Recommendations

Based on the findings of the study, the following recommendations were made;

5. Counseling programs should be established specifically to address the unique mental health needs of sickle cell anemia patients.
6. The government should create gender-sensitive counselling interventions that recognize and address the distinct emotional and social support needs of male and female patients.

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APPENDIX I

PATIENTS WITH SICKLE-CELL ANAEMIA DISEASE QUESTIONNAIRE (PWSCADQ)

Dear respondent,

I am a post graduate student of Guidance and Counselling, Sokoto State University, Sokoto. I am currently conducting a research on **COUNSELLING NEEDS OF SICKLE CELL ANAEMIA PATIENTS ATTENDING GOVERNMENT HOSPITAL IN SOKOTO METROPOLIS.** Any information given would be treated with utmost confidentiality and for academic purpose only.

SHAFI'I ABDULLAHI

SECTION A: SOCIO-DEMOGRAPHIC CHARACTERISTICS OF RESPONDENTS

1. **Sex** (a) Male [ ] (b) Female [ ]

2. Age (a) 10-15 years [ ] (b) 16-20 years [ ] (c) 21-25 [ ] d) 26-30 [ ] e). Over 31 years [ ]

3. Marital status (a) Single [ ] (b) Married [ ] (c) Divorced (d) Widow [ ]

4. Highest Educational Qualification

(a) Secondary [ ] (b) Diploma [ ] (c) B.sc/ HND [ ] (d) Masters [ ] (e) P.hD [ ]

Others specify _____

5. Are you a sickle-cell anemia patient?

(a) YES [ ] (b) NO [ ]

SECTION B: TO EXAMINE THE COUNSELLING NEED OF SICKLE-CELL ANAEMIA PATIENTS ATTENDING GOVERNMENT HOSPITAL IN SOKOTO METROPOLIS BASED ON THEIR MENTAL HEALTH					
S/N	QUESTION	SA	A	D	SD
	Sickle cell condition affect my mental health				
	Sickle-cell anaemia disease is a major source of stress that impedes the academic achievements of a sickle cell anaemia patients				
	My academic goals have been impeded by sickle cell anaemia condition				

	The current counselling services available to address the challenges you face in your mental health due to sickle cell anaemia?				
	Counselling support you receive to the enhancement of your mental health while dealing with sickle cell anaemia?				
SECTION C: TO EXAMINE THE COUNSELLING NEEDS OF SICKLE-CELL ANAEMIA PATIENT, ATTENDING GOVERNMENT HOSPITAL IN SOKOTO METROPOLIS, BASED ON THEIR GENDER DIFFERENCES					
	Gender has relationship with the challenges you face as a sickle cell anemia patient in your daily life				
	Psychological aspects related to sickle cell anaemia influence on your gender believe.				
	Counseling support benefit you in overcoming gender specific challenges as a sickle cell anaemia patient				
	Counselling services you have received so far in addressing gender-related concerns linked to your sickle cell anaemia				
	Counseling service is important in tailoring to address gender specific needs of sickle cell aneamia patient				
SECTION D: EXAMINE THE COUNSELLING NEED OF SICKLE CELL ANAEMIA PATIENT, ATTENDING GOVERNMENT HOSPITAL IN SOKOTO METROPOLIS, ON THE BASIS OF THEIR MARITAL STATUS					
	Challenges in sickle cell anaemia affect individual marital status				
	Sickle cell aneamia disease can affect spouse/marital status				
	Counseling services can address your emotional wellbeing				
	Counselling services received help to resolve addressing the challenges associated with sickle cell anaemia in the context of individual marital status				
	Counselling services should be used to address the specific needs of sickle cell anaemia patients based on their marital status?				
SECTION E: EXAMINE THE COUNSELLING NEED OF SICKLE CELL ANAEMIA PATIENTS, ATTENDING GOVERNMENT HOSPITAL IN SOKOTO METROPOLIS, ON THEIR BASIS OF THEIR RELIGIOUS BELIEFS					
	Religious belief influence individual coping mechanisms with sickle cell anaemia				
	Counselling services aligned with individual religious belief have address the challenges associated with sickle cell anaemia				
	Availability of counselling services that are blended with religious belief in managing sickle cell anaemia				
	Religious belief play a vital role in shaping individual experience with sickle cell anaemia				
	Religious considerations play a vital role in designing and implementation of counselling services for sickle cell anaemia patients attending government hospitals in Sokoto metropolis				

Rima International Journal of Education (RIJE), Vol. 3 (No. 3): Nov 2024; P: 123-135 ISSN: 2756 - 6749

Record Planning and Storage as Essential Tools for Effective School Management: An Empirical Evidence

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Abstract

The study investigated the impact of record planning and record storage on effective management of senior secondary schools in Sokoto State, Nigeria. The study was guided by two research questions and their corresponding null hypotheses. The study adopted a descriptive survey design. The population of the study was 3,960, comprising of 222 principals, 444 vice principals, 2,406 teachers and 888 PTA officials in all the public secondary school in Sokoto State. A sample of 349 respondents was selected and a self- designed questionnaire titled 'Impact of Record planning and Storage on the Management of Secondary Schools in Sokoto State' (IRPSMSS) was used for data collection. The instrument was validated and 0.91 was obtained as content validity index. The questionnaire was pilot-tested and internal consistency reliability of 0.92 was obtained. Mean and Standard Deviation was used to answer the research questions, while Pearson Product Moment Correlation Co-efficient was used to test the hypotheses at 0.05 level of significance. The findings revealed that both record planning and storage have significant impact on the management of Secondary Schools in Sokoto State, Nigeria. It was thus concluded that record planning and storage are essential tools that enhance effectiveness in the management of public secondary schools. It was therefore recommended that governments at all level should positively intensify record planning and storage in secondary schools to improve the extent of management effectiveness. Principals should also consider and improve record planning and storage in their schools for proper information management.

Keywords: Record, Planning, Storage, Management, Secondary-school

Introduction

Records are the documented information generated, collected or received in the initiation, conduct or completion of an activity and that comprises sufficient content, context and structure to provide proof or evidence of the activity. Specifically, Agbo (2021) defined record as a unified, comprehensive collection of documentation concerning all services provided to a student which may include intake information, evaluation(s), assessment(s), release of information forms, individual learning plan, all written notes regarding the student, all collateral information regarding the student .Records are important aspects that are needed for effective functioning of a school as they are well needed

for proper decision making in schools (Agumya-Asbuny,2019).Since records are valuable and act as the backbone of every organization they should be handled and organized in good manner as they are potential for providing evidences and accountability for school administrative, financial, and academic functions (Ibura, 2011).

Record planning entails projecting in strategic term the kinds of record documents that should be provided, preserved and kept in an organization including educational ones. In other words, the concept involves creating action or arrangement about that combines the tactics, strategy and policies (Mabera, 2019). These actions will take place over specific times with specific resources levels and within specific center of responsibility. This method deals with the arrangement of records and files into different groups basing on their subjects so as to make sure that all records are logically arranged. In this case the logical arrangement of files appears to be central so as to ensure that all files should remain in their specific places for easily retrieval (Rose Ngozi Amanchunkwu, 2015).After planning has been determined and files have labeled, files should be arranged accordingly and be kept in a filing cabinet drawer, therefore after files have been properly placed in to the cabinets all files should be clearly labeled so as to be able to differentiate them from one another, (Nwachunkwu Prince Ololube,2015).

Record storage is a systematic process of securing and keeping document, file or information intact, it entails securing record from unauthorized access, tempering, deletion or loss. Record is stored for as long as they are needed for fiscal, legal, research or administrative purposes among others. Dampson and Eshun (2018) noted that it is imperative for a manager to store records in media that ensure that their usability, reliability, authenticity and preservation for as long as user need them. Record storage is defined by Rogerst (2018), as any document that or other source of information compiled or recorded or storage in written form or on a film or in any other manner. Official records must be captured on official file in formal records management system or in an approved digital record management system. Record storage refers to the equipment and systems used to file records during their useful lifetime in an organization (Shehu, 2019). The author further maintains that record storage is essential for managing records because it ensures that records are secure and accessible for long as users need them. Olowole, (2019) also pointed out that record storage can be stored in to two forms namely: manual and electronic forms, furthermore the authors stressed that manual

storage practice involves keeping this record inform of printed material in files, shelve or drawer, while electronic practice involve keeping records in electronic device such as computer and flash drive among others.

Record planning and storage have a greater influence on School Management. This suggests the planning and arrangement of records and files into different groups basing on their subjects so as to make sure that all records are logically arranged. In this case the logical arrangement of files appears to be central so as to ensure that all files should remain in their specific places for easily retrieval (Rose Ngozi Amanchunkwu, 2015). Record storage is a systematic process of securing and keeping document, file or information intact, it entails securing record from unauthorized access, tempering, deletion or loss (Nwachunkwu Prince Ololube, 2015).

Researchers have carried out various studies to examine different variables of records for instance, Odeniyi and Adeyanju, (2020) carried out a study with the purpose of assessment of school record management in secondary schools in federal capital territory Abuja. The descriptive research design was used for this study. The population was drawn from ten (10) secondary school in federal capital territory Abuja. The instrument for data collection was a questionnaire. A sample size of eighty (80) respondents from schools was used. Simple percentage was adopted in analyzing the research question while chi-square was adopted in analyzing the hypotheses. Research finding revealed that various school records that are currently kept in secondary school include; admission and withdrawal register, logbook, attendance register, school time table, diary, visitors' book, exam records, time movement book and a host of others. This is in line with the view of Olubebe (2013) which highlights the kind of records kept in schools. The results also revealed that school records are not properly kept as most of the seemingly kept records are not properly and effectively kept. This is in agreement with the view of Chifwepa, (2014) which opined that poor record keeping can be linked to policy summersault. Results also unveiled some strategies for improving on school records management in schools which include: timely supply of relevant school records, making funds available for record keeping purpose, training of personnel who keep records on a daily basis in school and finally providing proper back-up device for school records. This is equally in tandem with the assertion of (Olubebe, 2013).

Oluwole and Dondo (2015) carried out a study on record keeping and effective management of secondary schools in zone B Senatorial District of Benue State, Nigeria. The study adopted the survey research design. The population of the study comprised of 3704 teachers from 232 public and private secondary schools in Zone B Senatorial District of Benue State Nigeria. A sample of 370 out of 3704 teachers representing 10% of the total number of teachers was randomly selected from 23 out of 232 secondary schools representing 10% for the study. Simple random technique was adopted to select the sample size because the population was homogeneous. A 10-item structured questionnaire was used for data collection. The data collected were analyzed using descriptive statistics of mean and standard deviation to answer research questions while the chi-square (x2) test of goodness of-fit was used to test the hypotheses at 0.05 level of significance. The first finding of this study revealed that historical records have significant impact on information dissemination in secondary schools in Zone B Senatorial District of Benue State, Nigeria. This finding is in agreement with the views of Adeyemo (2001) who opinioned that announcement book is a record book that records all the important announcements of the school. It is kept by the principal as evidence that all essential announcements get to the teachers in the school. Announcement book is very essential in the management of secondary schools. Similarly, Nwagwu (2007) stated that announcement book serves the school administrator very useful purposes. This is because, there are some pieces of information which the school administrator may want his teacher only to know. Such information is therefore not made available during school assembly but is written in the announce book and circulate among members of staff only. It is therefore safe to conclude that announcement book provides effective communication system in the school. The second finding of the study revealed that financial records have significant impact on accountability in secondary schools. This finding is in consonance with the opinion of Eno (1998) who maintained that the information in the school fees register helps the school administrator to avoid sending a learner home in error when they have paid their school fees and also make the process of accountability easier. The register also aids parents and guardians who are in doubt of school fees status to get clarification. It also reduces corrupt and sharp practices. To crown it all, the school fees register provides information even when receipts are not available even as it aids the school head to know how many students that have paid their school fees as well as financial position of the school.

Similar in support to the finding, Eno, (1998) stated that financial records deal with the management of schools' money.

Statement of the problem

With respect to the significance of record planning and storage in schools for the achievement of the aim of school creation, it was observed that these records were not adequately managed by the school administrators. Despite the main purpose of record keeping in the school system, the management of records in secondary schools in Nigeria still left much to be desired for effective administration. This suggests that school record planning and storage management practice in Nigeria has a number of issues. Based on these facts, it is glaring that a problem exists and this is the concern of this study. In spite of government policies, laws, regulations and public service schemes, it requires that both public and private schools should keep the school records for both teachers and students, but there are still many schools which are not able to keep and manage school records hence may result to the lack of sensitive records. The failure of school management to provide some records to support teachers and other stakeholders for their employment claim and failure of students to get their sensitive records on time such as academic certificates, as well as continuous assessments records have raised some questions among the researchers whether the school managements keep school records, (Nice Ephraim Ngasala, 2015). This research therefore seeks to examine the extent to which record planning and storage influence effective management of public secondary schools in Sokoto State Nigeria.

Research Questions

The study seeks to answer the following research questions:

1. To what extent does record planning affect the Management of Senior Secondary School in Sokoto State?

2. To what extent does record storage affect the Management of Senior Secondary School in Sokoto State?

Research Hypotheses

The following null hypotheses are tested at 0.5 level of significance:

Ho1: Record planning has no significant impact on the Management of Senior Secondary School in Sokoto State.

Ho2: Record storage has no significant impact on the Management of Senior Secondary School in Sokoto State.

Methodology

A descriptive survey research design was adopted for the study. According to Nwagwu (2007), descriptive survey design is one of the best designs for describing situation without manipulation. The population of the study comprised of 3,960 subjects which are made up of all the 222 principals, 444 vice principals, 2,406 teachers and 888 PTA officials of all the 222 public senior secondary school in Sokoto State. The researcher first determined 349 as the sample size of the population as guided by Research Advisor (2006).The instrument used for data collection was a self-designed questionnaire titled "Impact of Record Planning and Record Storage in the Management of Senior Secondary School in Sokoto" (IRPSMSS). The questionnaire consisted mainly of close-ended structures which required the respondents to tick their best option and structured on three-point scale i.e. A= Agreed, D= Disagreed and C= UD Undecided. Descriptive statistics of frequency counts, percentages, mean and standard deviation were used to answer research questions, while inferential statistics (Pearson product moment correlation co-efficient) were used to test the research hypotheses at 0.05 level of significance.

The Results

Results of the study were presented based on research questions and hypotheses accordingly as follows:

Research Questions One: To what extent does record planning affect the Management of Senior Secondary School in Sokoto State?

Responses with regards the above research question are presented in Table 1. as follows:

Table 1: Record Planning as it affects the Management of Secondary Schools

s/n	Variables	Freq.	Rate	$\bar{x}$	SD	Extent
1	Record planning	310	90.10%	2.702	.30566	High
2	Management of Secondary School	305	88.55%	2.656	.08273	High

Source- Field Survey (2024)

The presented data in table 1, shows the effect of record planning on Management of Secondary Schools. The result revealed that record

planning was rated 90.10% with frequency of 310, mean scored of 2.702 and Standard Deviation of 0.30566, indicating that the extent to which record planning influences the management of secondary schools in Sokoto State is high. This is understood from the statistical figures where the management of secondary schools was rated 88.55% with frequency of 305, mean scored of 2.656 and Standard Deviation of 0.08273. Thus, the extent of record planning was rated higher than the extent of Management of Secondary Schools in Sokoto state, Nigeria (record planning mean scored (2.702) >Management of Secondary Schools mean scored (2.656). Therefore, record planning may affect the Management of Secondary Schools in Sokoto State.

Research Question Two: To what extent does record storage affect the Management of Senior Secondary Schools in Sokoto State?

Information with regards the above research questions are presented in table 2 as follows:

Table 2: Record Storage as it affects the Management of Secondary Schools

s/n	Variables	Freq.	Rate	χ	SD	Extent
1	Record Storage	307	89.33%	2.682	.38033	High
2	Management of Secondary School	305	88.55%	2.656	.08273	High

Source- Field Survey (2024)

The presented data in table 2, shows the extent of record storage and Management of Secondary Schools. The result revealed that record storage was rated 89.33% with frequency of 307, mean scored of 2.682 and Standard Deviation of 0.38033, indicating high extent of record storage in Secondary Schools in Sokoto state, Nigeria. Management of Secondary Schools was rated 88.55% with frequency of 305, mean scored of 2.656 and Standard Deviation of 0.08273, indicating high extent of Management of Secondary Schools in Sokoto state, Nigeria. Thus, the extent of record planning was rated higher than the extent of Management of Secondary Schools in Sokoto state, Nigeria. Record storage mean scored (2.682) >Management of Secondary Schools mean scored (2.656). Therefore, record storage may affect the Management of Secondary Schools in Sokoto State.

Null Hypothesis One: Record planning has no significant impact on the Management of Senior Secondary Schools in Sokoto State.

Table 3: Impact of Record planning on the Management of Secondary School

SN	Variables	N	χ	SD	DF	Chi-Square value	P-value	Decision
1	Record planning	344	2.702	.30566				
2	Management of Secondary School	344	2.656	.08273	12	339.015[a]	.000	Ho1 Rejected

Alpha level = 0.05

Table 3, reveals the number of participants (n) = 344, and a Chi-Square value= 339.015aand P-value of .000. Testing the hypothesis at alpha level = 0.05. The P-value is greater than alpha value, .000 < 0.05. Hence the null hypothesis which states that Record planning has no significant impact on the Management of Senior Secondary Schools in Sokoto State is rejected. Therefore, there is record planning has significant impact on the Management of Secondary School. This means that the record planning has the potential to enhance effective management of Secondary School in Sokoto State, Nigeria. By implication, it means that Record planning leads to effective Management of Secondary Schools in Sokoto State, Nigeria.

Null Hypothesis Two: Record storage has no significant impact on the Management of Senior Secondary School in Sokoto State.

Table 4: Impact of Record storage on the Management of Secondary School

Variables	N	χ	SD	DF	Chi-Square value	P-value	Decision
Record storage	344	3.8639	.70571				
Management of Secondary School	344	2.656	.08273	16	271.593[a]	.000	Ho2 Rejected

Alpha level = 0.05

Table 4, reveals the number of participants (n) = 344, and a Chi-Square value = 271.593a and P-value of .000. Testing the hypothesis at alpha level = 0.05. The P-value is greater than alpha value, .000 < 0.05. Hence the null hypothesis which states that Record storage has no significant impact on the Management of Senior Secondary Schools in Sokoto State is rejected. Therefore, there is significant Impact of Record storage on the Management of Secondary School. This means that the Record storage enhance the Management of Secondary School in Sokoto State, Nigeria. By implication, it means that Record storage leads to the effective Management of Secondary Schools in Sokoto State, Nigeria.

Discussion

Findings from the first research question suggests that the extent to which the record planning affects the management of secondary schools in Sokoto State was high. Equally, findings from the first hypothesis indicate that record planning has a significant impact on the Management of Secondary Schools in Sokoto State, Nigeria. These findings are in line with that of Eseoghene and Oghenevwogaga (2021) who established that school records keeping has significant influence on school financial Management in secondary schools in Zone 'A' Senatorial District of Benue State-Nigeria. This suggests that school heads must imbibe the culture of record planning for them to achieve effective management of their schools.

Findings from the second research question indicated that the extent to which the record storage affects the management of secondary schools in Sokoto State was high. Similarly, the second hypothesis of the study revealed that record storage has a significant positive impact on the Management of Secondary Schools in Sokoto State, Nigeria. The finding was in line with Udofia and Ikpe (2012) who said that school records have greater influence in the management of school financial records in secondary schools because they give details of all financial transaction ad expenditure as such there is transparency in schools management, facilities, resources, materials, equipment among others. This implies the need for school managers to be storing their records carefully for them to be able achieve effective management of their schools

Conclusion

Based on the findings of the study it was concluded that record planning and storage are essential food effective school management as they have significant positive effect towards that. Therefore all hands must be on deck to ensure proper planning and storage of records for effective management to be met in all the secondary educational systems in the State.

Recommendations

Based on the findings and conclusions from this study the researcher recommends that:

1. Government at all level should positively intensify record planning in secondary schools to improve the extent of effective management, so that to meet up with current challenges.

2. Principals should consider and improve record storage in secondary schools and its techniques in handling them to improve their management of their schools.

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Rima International Journal of Education (RIJE), Vol. 3 (No. 3): Nov 2024; P: 134-xx ISSN: 2756 - 6749

Enhancing Relevance and Authenticity in STEM: Exploring Biomimecry in a Frog – Inspired Robot Designs in Developing Pre- School Children's Manipulative Skills in STEM

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Abstract

This study explored biomimecry in a frog – inspired robot designs in developing pre-school children's manipulative skills in STEM in Mangu Local Government Area, Plateau State, Nigeria. The research aims to assess the impact of manipulating robot components on children's motor skills and engagement, comparing the outcomes in experimental and control groups. The methodology involves constructing a frog robot using accessible materials and measuring children's skill acquisition in various tasks, such as gumming, fixing, and operating the robot. Findings reveal significant differences between the experimental and control groups, indicating that the experimental group demonstrated higher proficiency in manipulative skills owing to hands-on interaction with the robot, whereas the control group exhibited limited skill acquisition. This underscores the potential of nature inspired educational robotics as a transformative tool in manipulative skills development in early childhood education level. It was recommended that pre service teachers trained on integrating play-based learning approaches to enhance children's problem solving and learning l outcomes.

Keywords: Relevance, Authenticity Biomimecry, Robot designs, STEM manipulative skills

Introduction

Relevance and authenticity are essential components of Science Technology Engineering and Mathematics (STEM) education and research. By ensuring that STEM content is relevant and authentic, educators can prepare learners for real-world challenges, foster critical thinking, inspire innovation, and bridge the gap between theory and practice. One problem that continues to inhibit progress in STEM worldwide and especially in Nigeria in particular is the lack of hands activities and use of relevant content linked to Nigeria problems and industry needs in the instructional process (Duguryil, et al. 2024; Katniyon, et al. 2023). A concept seems to have been ignored among others is the concept of biomimicry.

Biomimicry, also known as biomimetics, is the practice of drawing inspiration from nature and its biological systems to design and develop innovative engineering solutions for human challenges (Tomborini, 2024). Nature has long been a source of inspiration for human innovation, with biomimicry emerging as a powerful tool for solving complex engineering challenges. Biomimicry, the practice of emulating nature's strategies and processes, has led to ground breaking advancements in robotics, materials science, and energy harvesting. Among the diverse range of biomimetic inspirations, frog biology offers unique opportunities for robot design (Huang et al 2024). Frogs have remarkable jumping ability, agile locomotion, and adaptable skin have captivated scientists and engineers. By emulating these features, researchers aim to create robots that can: navigate challenging terrain, achieve efficient locomotion, and interact with environments in novel ways. Thus, successful biomimicry include velcro: inspired by burrs' hook-and-loop mechanism. Another example is seen in sharkskin surfaces which is used in reducing drag and improving fluid dynamics. Also, lotus effect surfaces: self-cleaning and water-repellent materials, whale fin wind turbines and efficient energy harvesting. Another example of successful use of biomimicry is in gecko inspired adhesives used in reversible and strong adhesion. biomimicry is applied to energy and environment medicine and healthcare, materials science, robotics and engineering, aerospace and transportation. Thus from the usefulness of bio mimicry studying the adaptations and abilities of living organisms, children can develop innovative solutions to real-world problems. Frogs, with their remarkable jumping ability, camouflage, and sensory capabilities, provide an ideal subject for biomimicry-inspired robotics. Robotics, in particular, has benefited significantly from biomimicry. By studying the remarkable adaptability and efficiency of living organisms such as jumping robots, researchers have developed innovative robot designs capable of navigating complex environments, interacting with humans, and performing tasks with precision (Huang et al 2024). Robotics education have become increasingly important in modern education, as they prepare children for careers in science, technology, and innovation. However, a gap existing in literature is that few research seems to have been done regarding children’s engagement in bio mimicry inspired robotic designs. The integration of robotics education into STEM education provide a unique opportunity for children to engage in hands on, project-based learning experiences that foster creativity, problem-solving, and critical thinking (Katniyon et al. 2023). Research Duguryil et al. (2024) has shown that hands-on, project-based learning experiences in robotics and STEM education

can: enhance children's interest and motivation in STEM subjects, develop problem-solving and critical thinking skills, improve collaboration and communication among team members, and foster creativity and innovation. However, there is a need for more research on bio mimicry-inspired robotics design, particularly in the context of children's manipulative skills development in STEM in Nigeria. This study aims to investigate how pre-school children design and build frog-inspired robots, exploring the development of STEM skills and creativity in this context.

Research Huang et al (2024) has shown that robotics for children can become a tool that aids in the understanding of abstract and complex concepts in science and technology courses as well as facilitate creative thinking. It can also serve as a great tool for building teamwork among children. The teacher or educator can come up with interesting programming and coding activities and conduct interactive team challenges with the help of customizable robots.

As a consequence, greater attention must be focused on how educational robots can be better integrated into the lives of young people. With the continuous advent of technology, it is worthwhile to understand the potential of robots as effective add-ons to learning. Robots can also be used in entertaining platform to learn about computers, electronics, mechanical engineering and languages. According Duguryil et al (2024) research has been shown that young children performed better on post-learning examinations and generated more interest when language learning took place with the help of a robot as compared to audiotapes and books. Educational robots are a subset of educational technology, where they are used to facilitate learning and improve educational performance of students.

Study by Peter (2013) reveals what these encounters are all about in different kinds of learning environments and it further develops a substantive theory regarding encounters in the dimensions of technological access and individually experienced ownership. Educational robotics refers to any robot technology that fulfils the technical requirements of robotics and which is applied to education in order to learn with, from and about it. Encounters include several aspects, such as technological and pedagogical design of the learning environment and children's individual interests. These are all relevant elements to the success of robotics for education. The success of educational robotics depends on elements that, on the one hand, promote children's engagement and, on the other hand, pushes

toward indifference with it (Duguryil et al., 2024). Since children are the end users of educational robotics and their action with it indicates whether educational robotics can be used successfully as a learning tool, an understanding of these encounters is essential. In order to reveal the potential and overcome the barriers of educational robotics for education, a more detailed understanding regarding educational robotics in learning contexts is needed.

Children's learning of and through robotics can be assessed using various methods, such as multiple-choice questionnaires, design scenarios, artifact-based interviews, and project analyses (Katniyon, et al., 2023). There are benefits and limitations to each method. For example, questionnaires allow for standardization and measurement of discrete skills. Design scenarios and artifact-based interviews are subjective measures but allow for more nuanced assessment of children's conceptual understanding. Project analyses offer insight into the conceptual encounters a child may experience over the course of designing their project; however, encounters do not necessarily equate to mastery. However, quantity should be paralleled with quality. Assessments must be developmentally appropriate (in this case, for young children) and demonstrate purposeful value for research and practice.

Using robotics to support various applications has become considerably more prevalent during the past decade (Shinozawa et al., 2017). In particular, employing robotics in an educational context has become a widely researched topic. Most robots examined in previous studies involve using a tangible user interface and an anthropomorphic robotics body that attracts users' attention and facilitates socially meaningful interactions. Numerous studies have concluded that the actions of robots leave strong impressions on users. Shinozawa et al. (2017) asserted that a robot's motions and body gestures can provide strong motivators that affect user decision-making processes. Nishimura et al. (2018) compared audience impressions of an educational robot presentation with those of a computer animated agent presentation. Their results showed that the robot resulted in enhanced impressions on audiences. Thus, physical robots are expected to be useful as aids in many interactive fields as well as developing computational thinking, educational robots promote the development of other cognitive skills among children and young people: Learning from mistakes: discovering that errors are not final but a source of new conclusions is a valuable lesson for the future.

The design and application of model of frog robot is consistent with several contemporary learning theories. Some evidence is available that the use of model of frog robot in education has a positive impact on student behavior and development, especially in problem-solving and manipulative skills, collaboration, learning motivation, participation, and enjoyment and engagement in the classroom. These studies drew mixed conclusions about the effectiveness of robotics in education. Researchers have been actively exploring the use of model of frog robot in a wide range of courses. For example, Parks (2017) reported that the use of model of frog robot was beneficial for skill development in children. Earlier, Toh et al (2009) found that the use of robots helped improve the knowledge of concepts. Huang et al (2024) showed that model of frog robot could enhance students' interest in engineering and help them gain a better understanding of scientific processes in a biomimetic design. Furthermore, review of literature shows that model of frog robot are a constantly evolving field with the potential to be implemented in education at all levels from kindergarten to university. Chin et al. (2016) indicated that model of frog robot can provide primary school teachers with tools to increase student achievement. Previous systematic review studies have reported the potential contribution of model of frog robot in schools. However, there is a growing criticism from the robotics community in recent years over the lack of empirical research on how model of frog robot can be employed to improve pupil's manipulative skills and learning in general. Few of the empirical studies reviewed support the significance of using model of frog robot in classroom in Nigerian context. From literature most of these research are in China and the USA few research seems to have been carried on this area and thus creates a gap requiring this research. For this reason this research will be conducted to explore biomimicry in a frog – inspired robot designs in developing pre- school children's manipulative skills in STEM in Mangu LGA.

Objectives of the Study

The study is aimed at enhancing relevance and authenticity in STEM by exploring biomimicry in a frog – inspired robot designs in developing pre- school children's manipulative in Mangu L.G.A. Specifically, the study sought to:

1. Examine the extent to which pupils in the experimental and control group able to use manipulating skills of geometric shapes of the frog robot.

2. Examine the extent to which experimental and control differ in skills of gumming in frog model.
3. Examine the extent to which experimental and control differ in skills of gumming in frog model.
4. Examine the extent to which experimental and control differ in fixing of frog robot model.
5. Examine the extent to which experimental and control differ in frog robot hopping test.

Research Questions

For the purpose of the study, the following research questions were raised to guide the study thus:

1. To what extent are pupils in the experimental and control group able to use manipulating skills of geometric shapes of the frog robot?
2. What extent do experimental and control differ in skills of gumming in frog model?
3. What extent do experimental and control differ in skills of gumming in frog model?
4. What extent do experimental and control differ in fixing of frog robot model?
5. What extent do experimental and control differ in frog robot hopping test?

Methodology

The experimental design was used in various stages of construction of frog robot. Materials used include:

Carton

A carton is a box or container made of paperboard, or other materials, used to hold or store various products, such goods, or to package and distributing goods. Size of them carton we used. Length 5.5cm, the base is 5.5cm and the height triangle is 4cm.

D.C Motor

A DC motor is defined as a class of electrical motors that convert current electrical energy to mechanical energy.

Small Switch

A switch is an electrical component that can allowed you to control the flow of electricity or other signals by opening or closing a circuit. In the context of frog robot a switch could be turn the robot on or off control motors or movements (e.g trump, walk, or crawl).

Rubber Band

A rubber band is a loop of rubber used to hold things together or provide tension. In the context of frog robots, a rubber band could be used as a power source, for movement in a frog robot legs, arms, or other components.

Cutter

A cutter is a tool use to cut or remove materials from an object. In the context of frog robot a cutter could be used to shape or modify components.

Battery Connector

A battery connector is a gadget that combines electric circuits. Most battery packs require more than one connector. The primary battery connect is both the mechanical and electrical part that interfaces the battery to the P.D.A or other electronic gadget.

9v Battery

The nine-volt battery or 9-volt battery, is an electric battery that supplies a nominal's voltage of a volts.

Roller

A roller is a cylindrical or spherical object that rotate or moves freely, often used to reduce friction or facilitate movement. In the context of frog robots, a roller could be used as a wheel that facilitate movement.

Give Gum refers to a Type of Adhesive

Derived from natural or synthetic sources often used in industrials application. It could refer to natural gum, synthetic gum, gum Arabic and rubber based adhesive.

Stick

Stick is a straight branch or stick of wood typically used as a support or structured element in the context of frog robot, a stick could be used as a balance, beam or gripper to manipulate object.

Ruler

A standard ruler is a straightedge with equality spaced markings, used to measure distances or draw straight lines.

Manipulative skills used in Design and Testing process include:

Gumming

After gumming the floor with 2 triangular shape, the DC motor is placed on the center floor of the robot using glue to gum it. Glue is used to gum the materials to maintain firmness.

Connecting of Components

Cables and connector are used for connecting battery to DC motor firmly.

Safety Precautions Undertaken

- Using of hand gloves to avoid hand sticking to glue.
- Wearing of nose masks to avoid plastic dusts and chemical inhaling from glue.
- Wearing of goggle glass to protect your eyes during gumming and coupling.

Design and Test procedure

Design Procedure

The following are the procedures for designing and testing of frog robot:

Place the empty carton on the table. Measure it with a ruler with the required CM, Cut the rectangular shape and four triangular shapes Drilling of the shapes for arms coupling. , Gumming of two triangular shapes on the rectangular floor. Add DC motor, all battery on the rectangular floor. Then add battery connector on the battery to connect the battery and the DC motor. Add glue to gum both the battery, 9v battery DC motor switch and battery connector on the rectangular floor. Then passing the stick through the hold of the roller for coupling the arms. Inserting of rubber band on the roller to make it roll. Fixing of two triangular shapes besides the first two triangular shapes with the sticks. Gumming the edges of the stick to enable it not to remove. Testing of the frog robot by switching it on to see whether it will hop or jump.

Step 1: Cutting/Gumming

We used cutter for cutting the carton into shapes of four triangular and one rectangular for the floor in order to create a medium for pacing the DC motor, 9v battery and the switch.

Figure: 1 Gumming stage

Step 2: Connecting the 9v, DC motor

Figure 2: Connecting to DC motor

After gumming the floor with 2 triangular shape, the DC motor is placed on the centre floor of the robot using glue to gum it and wire connection to the battery for the purpose of hopping/ jumping.

Step 3: Fixing of parts

Figure 3: Fixing of parts

Coupling of frog arms and fixing it at the correct angles.

Step 4: Jumping/ Hopping Test

Figure 4: Hoping test

After all the components are fixed, we then switch on the robot to see whether it can jump or hop.

Step 5: Rear view of finished model

Figure: 5 Rear view of model

Step 6: Side view of finished model

Figure 6: Completed Model

After testing with the battery apart, showing proper hoping and jumping. The battery is then fixed firmly and the final test is done with proper jumping or hopping.

Results

RQ1: To what extent are pupils in the experimental and control group able to use manipulating skills of geometric shapes of the frog robot?

Table 1: Mean Responses of experimental and control group on the use manipulating geometric shapes of the frog robot design

Skills Usage							
Group	Excellent	Good	Fair	Poor	Total	$\bar{X}$	Decision
Experimental Group	3	7	2	3	15	2.67	Accept
Control Group	0	3	3	9	15	1.6	Reject

The data presented in Table 1 evaluates the proficiency of pupils in both the experimental and control groups in utilizing manipulating skills associated with geometric shapes of a frog robot, providing insights into their capabilities based on their self-assessments. In the experimental group, the distribution of responses shows that 3 pupils rated their skills as 'Excellent,' 7 as 'Good,' 2 as 'Fair,' and 3 as 'Poor,' which culminates in a mean score of 2.67. This relatively high average suggests that the experimental group possesses a notable level of proficiency and confidence in their ability to manipulate the geometric shapes effectively, indicating a positive outcome likely influenced by the instructional techniques or tools utilized during their learning process. Conversely, the control group exhibited a starkly different performance, with no pupils rating their skills as 'Excellent,' only 3 indicating 'Good,' 3 as 'Fair,' and a significant 9 categorizing themselves as 'Poor.' This resulted in a mean score of 1.6, reflecting a much lower level of skill proficiency and suggesting that these pupils

either struggled with or did not engage effectively with the geometric manipulation tasks. The comparative results illustrate a clear distinction between the two groups, validating the effectiveness of the experimental approach in fostering skill development, while the control group's lower ratings reflect a rejection of their capacity in this domain. Overall, the data suggests that the experimental group was substantially more effective in acquiring and demonstrating manipulating skills with the frog robot, highlighting the critical role of targeted educational strategies in enhancing learning outcomes.

RQ2: What extent do experimental and control differ in skills of gumming in frog model?

Table 2: Mean Responses of experimental and control differ in skills of gumming in frog model.

Skills Usage							
Group	Excellent	Good	Fair	Poor	Total	$\bar{X}$	Decision
Experimental Group	5	7	2	1	15	3.07	Accepted
Control Group	1	4	3	7	15	1.93	Rejected

Table 2 provides a comparative analysis of the abilities of pupils in both the experimental and control groups concerning their skills in "gumming" with a frog model, measuring how these skills differ between the two groups. The experimental group demonstrates a noteworthy level of proficiency, with 5 pupils rating their skills as 'Excellent,' 7 as 'Good,' 2 as 'Fair,' and only 1 as 'Poor.' This distribution results in an impressive mean score of 3.07, which signifies a strong grasp and effective application of gumming skills among the participants, reflecting positively on the educational strategies employed in this group. In contrast, the control group showcases a lower skill attainment, with only 1 participant marking their ability as 'Excellent,' 4 as 'Good,' 3 as 'Fair,' and 7 indicating 'Poor.' This leads to a mean response of 1.93, revealing a significant deficit in skill levels compared to the experimental group. The stark contrast between the two groups underscores the effectiveness of the instructional methods used in the experimental setup, highlighting a successful engagement in developing gumming skills with the frog model. Collectively, these findings depict a clear differentiation wherein the experimental group not only exhibits greater confidence in their gumming abilities but also reinforces the impact of targeted intervention on skill acquisition, as evidenced by the acceptance of their higher-level competencies, while the control group's results reflect a rejection of their comparative capabilities in this area.

RQ3: What extent do experimental and control differ in skills of gumming in frog model?

Table 3: Mean Responses of experimental and control on skills in connecting DC motor skills in frog Robot

Skills Usage							
Group	Excellent	Good	Fair	Poor	Total	$\bar{X}$	Decision
Experimental Group	6	5	2	2	15	3.0	Accepted
Control Group	2	3	2	8	15	1.93	Rejected

Table 3 presents an assessment of the differences in skills related to connecting DC motor functionalities using the frog model between the experimental and control groups. The responses indicate that the experimental group demonstrates a commendable level of competence, with 6 participants rating their skills as 'Excellent,' 5 as 'Good,' 2 as 'Fair,' and only 2 as 'Poor.' This results in a mean score of 3.0, suggesting that the majority of students in this group possess a solid understanding and ability to effectively connect DC motors within the context of the frog model, likely a reflection of the educational strategies or hands-on experiences provided to them. On the other hand, the control group shows considerable struggle, as evidenced by their distribution of ratings: only 2 pupils assess themselves as 'Excellent,' 3 as 'Good,' 2 as 'Fair,' and a significant 8 marking their abilities as 'Poor.' This leads to a mean score of 1.93, indicating a stark proficiency gap compared to their experimental counterparts and highlighting challenges in grasping the required skills. The data clearly illustrates the effectiveness of the targeted learning interventions implemented in the experimental group, leading to a significant enhancement in their ability to connect DC motors using the frog model, while simultaneously underscoring the deficiencies in the control group's capabilities, thus validating the rejection of their skill level in this domain. Overall, the findings emphasize the crucial impact of instructional methods on skill acquisition and confidence in practical applications.

RQ4: What extent do experimental and control differ in fixing of frog robot model?

Table 4: Mean Responses of experimental and control in fixing of frog robot parts

Skills Usage							
Group	Excellent	Good	Fair	Poor	Total	$\bar{X}$	Decision
Experimental Group	9	3	3	0	15	3.40	Accepted
Control Group	4	0	4	3	15	1.80	Rejected

Table 4 illustrates the comparative proficiency levels in fixing a frog robot model between the experimental and control groups, revealing significant disparities in their skill sets. For the experimental group, an impressive 9 participants rated their skills as 'Excellent,' 3 as 'Good,' and 3 as 'Fair,' with none indicating 'Poor' skills. This distribution affords them a mean score of 3.40, underscoring a strong mastery of the skills required to fix the frog robot model, likely attributable to effective instructional methods and hands-on experience provided during the learning process, which appears to have instilled a high degree of competence and confidence among the participants. In stark contrast, the control group fares poorly in this assessment, with only 4 students rating their skills as 'Excellent,' none categorizing their abilities as 'Good,' while 4 rated themselves as 'Fair' and 3 as 'Poor.' This results in a significantly lower mean score of 1.80, indicating considerable difficulties in the required skill set and suggesting that the control group lacked the necessary exposure or training that would allow them to effectively acquire the fixing skills pertaining to the frog robot model. The marked difference between the two groups reinforces the effectiveness of the instructional approaches employed with the experimental group, ultimately validating the conclusion that the skills necessary to fix the frog robot model are considerably more developed in that group compared to their control counterparts, as seen in the acceptance of their higher skill levels versus the rejection of those in the control group.

RQ5: What extent do experimental and control differ in frog robot hopping test?

Table 4: Mean Responses of Experimental and control on Frog Robot Hopping Test

Skills Usage							
Group	Excellent	Good	Fair	Poor	Total	$\bar{X}$	Decision
Experimental Group	3	4	3	5	15	2.33	Rejected
Control Group	1	1	7	6	15	1.80	Rejected

In evaluating the differences between the experimental and control groups in a frog robot hopping test, the data presented in Table 4 indicates a significant distinction in skills usage between the two groups, as demonstrated by their mean responses. The experimental group shows a higher number of respondents rating their skills as "Excellent" (3) and "Good" (4), while the control group has only one respondent rating their skills as "Excellent" and one as "Good," with a substantially larger number of respondents (7) rating their skills as "Fair" and another 6 categorizing their performance as "Poor." This disparity reflects a mean score of 2.33 for the experimental group

compared to a mean of 1.80 for the control group, suggesting that the experimental group not only performed better overall but ultimately outperformed the control group in the frog robot hopping test. Both groups received a "Rejected" designation in their performance evaluation, indicating that while the experimental group displayed superior skills usage, neither group achieved an acceptable standard of performance. The findings indicate a clear advantage of the experimental group over the control, highlighting the effectiveness of the interventions or conditions applied to the experimental group as opposed to the standard conditions experienced by the control group.

Discussion

The findings from the research investigation highlight a compelling narrative regarding the skill acquisition and performance of pupils in the experimental and control groups when working with the frog robot model.

Regarding skills in geometric shapes manipulation in robot design data indicated a clear advantage for the experimental group in their manipulating skills with geometric shapes of frog robots, as demonstrated by a higher mean score of 2.67 compared to 1.6 for the control group. This disparity underscores the effectiveness of innovative educational strategies and suggests that the experimental group benefitted greatly from tailored instructional techniques that enhanced their understanding and proficiency with geometric shapes design skills. The ability to self-assess their skills positively is indicative of this group's confidence and engagement, which were likely cultivated through the hands-on approaches used in their learning. This finding aggress with Katniyon et al. (2023) who discovered that participants show marginal gains when exposed to design skills in robots design. This implies that STEM teachers should expose pre - scholars' to more design activities to enable gain skills for problem solving such as in biomimicry.

Findings from research on participants design skills of robot parts gumming skills, with the experimental group achieving an impressive mean score of 3.07 against the control group's mere 1.93. The substantial difference in ratings, particularly where the experimental group demonstrated higher proficiency levels with more pupils classifying their skills as 'Excellent' and 'Good,' illustrates the significant impact of targeted intervention. The experimental group's results strongly affirm the hypothesis that a structured learning model can facilitate better skill acquisition in practical applications, whereas

the control group's lower ratings suggest they remained disengaged or inadequately prepared, leading to their rejection in terms of skill proficiency. Similar study Abdullahi (2014) on sixth graders indicates that participants show gains when exposed to design skills in robots design. This implies that STEM teachers should integrate more design activities in their lessons to enable gain skills for creativity and problem solving such as in areas such as biomimicry.

Another skills assessed was the skills of connecting DC motor skills, the experimental group scored a mean of 3.0 compared to the control's 1.93, once again highlighting a clear proficiency gap. The overwhelming majority of the experimental group rated their skills positively, revealing that they not only grasped the concepts but also applied them effectively in practice. This contrasts with the control group's distribution of ratings, indicating substantial challenges with the task. The findings and relation to Katniyon et al (2023); Duguryil et al (2024) strengthen the argument that effective instructional methodologies enhance understanding and practical application of complex skills, leading to differentiated outcomes in student performance.

On ability and skills of fixing of the frog robot parts, the findings presented an even more pronounced disparity with a remarkably high mean of 3.40 for the experimental group against only 1.80 for the control group. The near absence of 'Poor' ratings among the experimental participants suggests a comprehensive grasp of the material, which likely stemmed from engaging instructional practices. This marked improvement correlates with findings of Duguryil, et al (2024); Abdullahi (2014) that hands-on experiences provided to the experimental group, establishing a strong foundation for their technical skills, unlike the control group that lacked similar experiences and showcased inadequate skill levels. This further validates the notion that immersive and participatory learning experiences are crucial for effective skill acquisition in practical fields.

Finally, regarding hoping test both groups in the frog robot hopping test, the results still revealed a substantial advantage for the experimental group with a mean score of 2.33 against 1.80 for the control group. This outcome suggests that, despite not achieving acceptable performance levels overall, the experimental group was still capable of better self-assessment and demonstrated a higher degree of skill usage. Duguryil et al (2024)and Huang et al. (2024) had found advantages with participants in an experimental design with brush

robots. The consistent pattern across all research questions suggests that the experimental interventions implemented resulted in a more effective learning environment, reinforcing the assertion that dedicated instructional strategies significantly enhance skill acquisition in technical domain tasks. Collectively, the findings from this research present a compelling case for refining educational approaches to foster greater engagement in robot design to improve skill proficiency in students working with robotic systems, ultimately laying the groundwork for future research and practical applications in similar educational contexts aimed at addressing global and national challenges.

Conclusion

Having achieved the purpose of the project though there was initial delay in the execution of the project due to inability of frog to jump or hop, however refocusing of materials and weight related issues provided desired hopping of prototype. The design and testing of the robot ourselves participating from beginning to the end having a proper understanding for participants and future classroom applications in design activities.

Recommendation

Considering the positive impact of the project on the pupils and the department of early childhood care and education, entirely, the following recommendation should be taken into consideration;

1. The school should provide some materials and tools that will be used during the practical and project execution, for examples; DC motor, battery, battery connector and also to help the pupils know how to use some equipment involve in design and testing.

2. The pupils should perform practical involve in the practice to acquire knowledge and skill in any project given.

Acknowledgement

Researchers acknowledge the funding support from IBR Federal College of Education and Tertiary Education Trust fund, Abuja towards this Research

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Rima International Journal of Education (RIJE), Vol. 3 (No. 3): Nov 2024; P: 153-174 ISSN: 2756 - 6749

Improving Pedagogical Content Knowledge of Pre-Service Mathematics Teachers through Integrated STEM (iSTEM) Strategy among Students of Sokoto State University, Nigeria

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Abstract

Stakeholders in education believed that the integrated Science, Technology, Engineering, and Mathematics (iSTEM) strategy is an effective pedagogy that provides the learners with innovative and higher-order thinking skills needed in the 21st century. Therefore, the purpose of this study was to explore the understanding of Pre-service Mathematics Teachers (PMTs) in improving their Pedagogical Content Knowledge (PCK) in teaching iSTEM strategy. The study was a qualitative research method that allows the participants to spell out their viewpoints on teaching iSTEM strategy. Six (6) participants were purposively chosen and the focus group data collected were analysed inductively using themes, categories, codes and thematic maps developed in line with the research purpose. Reliability includes an investigation of the stability or consistency of responses by checking the transcription and audio recordings. The two independent raters read the transcriptions and formed their categorisation based on the pre-defined set of themes to corroborate interrater agreement which happened to have the content validity index (CVI) of 0.97. The Cohen's Kappa coefficient between the raters was 0.87 suggesting a satisfaction level of agreement between the raters. The results portrayed that, the PMTs are fully prepared to teach the iSTEM lesson in a more holistic manner rather than in bit and pieces into their classroom instruction. Finally, it is recommended that a similar study should be conducted in all level of education as the importance attached towards the iSTEM education globally.

Keywords: Integrated STEM Strategy, PCK, Pre-service Mathematics Teachers

Introduction

The integrated Science, Technology, Engineering, and Technology (iSTEM) strategy is receiving an escalating global attention in tackling the 21st-century challenges on national growth and development. The iSTEM strategy improves the Pedagogical Content Knowledge (PCK) of Pre-service Mathematics Teachers (PMTs) practice to explicitly address teaching pedagogy necessary to have the skills necessary to incorporate the levels of integration, and also have the ability to teach iSTEM course. Specifically, it can be said that the PMTs with a sound knowledge of pedagogy and content can play an important role in

teaching iSTEM strategy (Lauermann & König, 2016; Martins & Baptista, 2024). In contrast, the PMTs with limited STEM pedagogy and content knowledge would encounter serious problems in teaching iSTEM strategy (Yıldırım & Sidekli, 2018).

Theoretical Foundations

The theoretical foundations that guided this study includes PCK and Adult learning theory (ALT). These theories hold a central position in providing a lens in which PCK and ALT are blended in preparing the PMTs to teach the iSTEM in their classroom instruction. The theory of PCK is originated from Bruner's social constructivist theory. The constructivist theory is important to this study as the PMTs was trained based on their prior knowledge and experience (Bruner, 1966). The theory of PCK linked to iSTEM in engaging students in hands-on and collaborative learning; students construct actively their own knowledge; teacher act as a facilitator; and engineering design challenges. Additionally, ALT is related to this study because of its principles aims at a learning environment where adults are the learners (Knowles *et al.*, 2014). Virtually, with regards to this study, the iSTEM course is a learning environment in which the PMTs in their 300 level 2023/2024 academic year at Sokoto State University, who are adults generally in the age range of the mid-20s to late 30s were the learners. Supporting the assertion, Mccall *et al.* (2018) mentioned that the students of such age range are increasingly in high enrollments percentage in the high institution of education. Moreover, PMTs have unique learning features that includes: they are rich in experience to draw from what they have already learned in the past; they have the strong knowledge base to decide on their learning styles, and they usually focus on the issues related to their work or personal life.

Literature

The Pedagogical Content Knowledge (PCK) of teaching iSTEM is a paramount strategy used to produce more PMTs' pedagogy and content knowledge that will support the PMTs abilities to teach iSTEM lessons. As such, Pre-service Mathematics Teachers (PMTs) are students at the colleges of education and university levels who are being trained to become certified teachers for schools within a formal teacher education program (National Research Council, 2010). Accordingly, Koirala and Bowman (2003), indicated that PMTs are much more likely to address integrated teaching strategies within and during their teaching method, particularly within their university

methods courses understand and teach STEM as an interconnected entity (Corlu *et al.*, 2015). Literature includes many outsets of how to expand PCK into the context of STEM integration in teaching (Kramarski & Michalsky, 2010; Sarkim, 2020). The literature review explicitly elucidates and elaborated in subsequent sub-headings:

2.1 Pedagogical Content Knowledge (PCK)

Pedagogical Content Knowledge (PCK) is defined as a type of teacher knowledge that contributed and developed by a teacher (Halim *et al.*, 2014). The idea of PCK is reliable with or similar to the idea of Shulman's knowledge of pedagogy that is related to the teaching a particular content. According to Shulman (1987); Umameh (2011), PCK is the knowledge of how to teach within a particular subject area. It signifies the blending of pedagogy and content into the understanding of a particular topic, issues or problem is prepared, adapted and represented to the diverse interests of the learners and abilities for presented and instruction. Considering what teachers need to know, Shulman (1987) determine the concept of PCK being consisting of pedagogical knowledge and content knowledge of effective instructional approaches. Also, the PCK is a type of knowledge that comprises an understanding of making the learning of specific content easy or difficult to learning and strategies to reorganise the understanding of learners. So, it is the blending or integration of teachers' pedagogical knowledge and content knowledge that originated from the PCK.

Furthermore, pedagogical content knowledge is a form of knowledge that is unique to teachers, and in fact, it is what the teaching is all about. It is concerning how the teacher relates to what they understand about teaching what they know about what they teach. However, researchers building on the Shulman's framework insights (Ball *et al.*, 2005; Grossman, 1990; Loewenberg Ball *et al.*, 2008) believe that many-dimensional acts of teaching are more than knowing the information; it is more than just an engaging delivery. PCK captures the teachers' understanding of knowledge of content within the dynamics of transforming that knowledge for students. These also consist of specific knowledge of content for teaching subject matter to indicate the complex nature of knowledge used during teaching (Vierra, 2011). Likewise, Shulman (1986) describe that the teacher need not only understand the meaning of something but the teacher needs to understand more about why it is so, on what

ground it can be asserted and to be able to communicate it to the students.

2.2 Integrated Science, Technology, Engineering and Mathematics (iSTEM) Approach

Many studies have been conducted within the last decades investigating and examining pre-service teachers with regards to integrated STEM content into their instruction (Berlin & White, 2012; Burrows & Slater, 2015; Frykholm & Glasson, 2005; Furner & Kumar, 2007; Koirala & Bowman, 2003; Niess, 2005; Stohlmann *et al.*, 2012). These studies all focus on providing meaningful learning requirements for PMTs to encourage integration and collaboration within the classrooms. This is in conformity with Stohlmann *et al.* (2012) statement on consideration for teaching iSTEM education that the teaching of integrated science and mathematics provide a good basis for teaching iSTEM education. Although iSTEM is considered to be very important in resolving from teaching single or separate STEM disciplines to teach in a more connected manner. There is a lack of preparing students in Nigeria to teach iSTEM lesson. Even in the situation where teachers attempt to teach all STEM subjects, the uncertainty regarding how well teachers truly understand each of the four STEM subject areas outside a specific area is of great concern (Ugo, 2016).

2.3 Pedagogical Knowledge (PK) for Teaching the iSTEM Course

The knowledge of pedagogy is necessary for improving the activities of STEM stakeholders in managing their classroom efficiently (Eckman *et al.*, 2016; Ejiwale, 2012). In relation to this, the pedagogical knowledge (PK) of the teachers and the content of the iSTEM needs attention. In view to this, Lauermann and König (2016) indicated that the teachers deep understanding of PK might play an important role in employing various instructions for improving a deep knowledge of the content and skills. This study used PK to highlight on the need to understand how best pedagogy employed in preparing the PMTs in teaching the iSTEM lessons.

2.4 Content Knowledge (CK) for Teaching the iSTEM Course

On the other hand, Knowledge of content for teaching iSTEM refers to the development of a deep understanding of content that the PMTs need to have for teaching iSTEM. Thus, Moore *et al.* (2014) identified

the development of a deep understanding of content as one among the six characteristics of STEM integration. As such, Content knowledge (CK) includes the actual knowledge of the subject matter that is to be learnt or taught, that has the potential to strongly influence how PMTs represent the content and design a learning experience and strategies to support the learners about the content to be taught. In this regard, Kaya (2009) revealed that the CK level of the pre-service teachers plays an essential role in the improvement of their PCK. The researcher further explained that the pre-service teachers with weak knowledge of CK had superficial knowledge (Kaya, 2009). It was further explained that the pre-service teachers with strong CK increase students understanding (Kaya, 2009; Van Driel *et al.*, 2002). In supporting this, the literature indicated that successful integrated STEM can effectively achieve with the development of CK (Eckman *et al.*, 2016; Halim *et al.*, 2014; Stohlmann *et al.*, 2012). In this study, the PMTs need to have a deep understanding of content knowledge in their ability to teach iSTEM in their future classroom instruction.

Although, due to the scarcity of empirical research on the iSTEM in Sokoto State Nigeria, these studies serve as an excellent starting point for researchers who wish to drive the future of pre-service teachers for iSTEM education. Numerous research studies conducted have promotes integration through effective means for not only teaching iSTEM education but also in raising the perceived value of iSTEM education among pre-service mathematics teachers (Furner & Kumar, 2007; Koirala & Bowman, 2003).

Research questions

This study explored the understanding of the PMTs in improving their PCK in teaching iSTEM strategy and the following research questions (RQ) guided the study.

1. How would iSTEM training improve the Pedagogical Knowledge (PK) of PMTs in teaching iSTEM course?

2. How would iSTEM training improve the Content Knowledge (CK) of PMTs in teaching the iSTEM course?

Methodology

This study adopted qualitative research method using case study design. A qualitative case study intensively allows the researcher to holistically analyse and interpret a phenomenon within its reality

(Creswell & Poth, 2017; Merriam, 2009). In this research, each participant was regarded as a case that helped and guided the researcher to obtain detailed information in answering the research questions earlier presented.

The participants in this study were the pre-service mathematics teachers (PMTs) who are in their 300-level teacher training programme in Sokoto State University (SSU) Nigeria. Purposive sampling was used in choosing a set of Six (6) participants that formed the focus group interview.

To assess the degree to which the interview was delivered as intended, the researcher focussed on training the students for better understanding of the five levels of STEM integration that included single, combine, multiple, engineering design and fully integrated STEM. To ensure the fidelity of the training, the researcher organised the participants to work in a small group of four to six in a group. During the intervention, the researcher acted as a facilitator that guided, assisted and emphasized on active participation and engagement of the participants. These features helped in developing learner's creativity, collaboration, brainstorming of ideas, team-work and logical thinking. The PMTs construct their learning environment and organised their learning which made them to improve in the teaching of iSTEM course under the guidance of the researcher.

In spite the fact that, the researcher is a member of the department of science education in the university where this study was conducted, "an introductory letter" seeking permission to conduct the research was presented to the university through the Head of the department. Permission was granted for the conduct of the research. To protect the right of the research participants as literature suggests (Kumar, 2018), the researcher presented a consent form to all the participants. Participants were also advised that they had the right at any point to withdraw from the study. The participants were also told that their participation would also be kept confidential and anonymous to protect them from a negative consequence or any harm. As such, the researcher used pseudo names to protect their identities. Also, to reduce the biasness, independent validators outside the university domain and experts were used for reviewing the research instruments.

Assessing iSTEM-SIQ Instruments

The integrated STEM semi-structured interview questionnaire (iSTEM-SIQ) was the instrument used in this study. The semi-structured

interview was used across disciplines because it gives the participants the opportunities to spell out their viewpoints on the phenomenon under study (Creswell, 2013). The interview was recorded with an audiotape via a smart-phone application named voice recorder and saved as audio files on an external storage unit and then transcribed the audio and manually analysed (Braun & Clarke, 2006). The focus group interview protocols were developed based on the literature; every interview question outlined to answer one category of the research questions. The focus group interview was lasted approximately 120 minutes duration and conducted at the mathematics laboratory. The focus group interview depends on the number of questions and the complexity of the issues but within one to two hours are sufficient for most discussions (Dilshad & Latif, 2013). During the interview, each participant in the group was asked to describe how the iSTEM training built their interest to teach the iSTEM lesson. Also, they were asked to describe how their overall participation helped them to grow and prepare to enter into the teaching of iSTEM content. The participants were also asked to identify their interest in pedagogical knowledge and content knowledge for teaching iSTEM lessons.

The reason for forming this set of the focus group interview is in line with the literature that, a focus group interview works well with around six to eight interviewees in each group (Creswell, 2013). Moreover, Dilshad and Latif (2013) suggested that the size of the focus group should range from six to eight participants preferably and it seem to be suitable for the number of the qualitative interview to reach saturation level (Guest *et al.*, 2006). It is argued that if the number is less than six, it is difficult to provide the synergy required. While a group with more than eight participants can be difficult to control (Krueger & Casey, 2002, 2014). However, interviews with the focus groups have their limitations, as some participants are reluctant to contribute to the discussions. Thus, in this study, the participants willingly said their mind and voluntarily participated.

Validity of the Instruments

In this study, the validity of the instruments was accomplished with the content validity index (CVI) of 0.97 obtained while distributed the instrument for validation to experts for content and construct validation. As a result of their input, all the items found to had substantial validity that deals with the checking of the accuracy of the results by employing certain strategies (Creswell, 2013). Some of the

strategies used to address the trustworthiness of the data are confirmability, credibility, dependability and transferability. These qualitative strategies mentioned in turn uses criteria like reflexivity, thick description and triangulation (Golafshani, 2003).

Reliability of the Instrument

The reliability of the instrument includes an investigation of the stability or consistency of responses. The two independent raters read the transcriptions and formed their categorisation based on the pre-defined set of themes to corroborate interrater' reliability. The Cohen's Kappa coefficient between the raters was 0.87 suggesting a satisfaction level of agreement between the raters. The researcher took the following approaches to check the qualitative interview reliability in this study: checking the transcripts and audio recordings to make sure that, they did not contain any unclear terms during transcription; authentication of the codes and their definitions.

The qualitative information or data was analysed inductively using thematic analysis as proposed by Braun and Clarke (2006) in answering the research questions. The thematic analysis employed was through the following six phases: Familiarising oneself with one's data; Generating initial codes; Searching for themes; Reviewing themes; Defining and naming themes; and Reporting. In this study, the researcher followed the above phases in analysing the data based on the individual responses, making codes, compared and categorised the themes with the findings of transcription of the focus group interview obtained and subsequently interpreted the findings. In this study, the interviewees that formed the focus group are coded as: PMT1, PMT2, PMT3, PMT4, PMT5 and PMT6 participants. The overall findings are presented in the subsequent subheadings.

Results

This part presented the overall findings of the study. The findings have been categorised into two subsections: interview analysis on PK for teaching the iSTEM course and interview analysis on CK for teaching the iSTEM course. The information was analysed using thematic analysis in answering the research questions.

Interview Analysis on PK for teaching the iSTEM Course

This section was designed to answer the qualitative research question in exploring how the iSTEM course training improves the PCK of PMTs

in teaching iSTEM using thematic analysis. This section gives the 6 participants (PMT1, PMT2, PMT3, PMT4, PMT5 and PMT6) that formed the focus group interview the opportunity to spell out their viewpoints about how the iSTEM course training improved their PCK towards the teaching of iSTEM course.

From the interview results, all the participants agreed that the iSTEM course training conducted helped them to improve on how they might use integrated STEM disciplines in their instructions. Two participants (PMT3 and PMT6) mentioned engaging the learners in learning engineering content by bridging mathematics and science disciplines as the way in which they would use iSTEM in their teaching instruction. Also, PMT1 and PMT4 said, "……connecting all the four STEM disciplines in one lesson to solve real-life problems". Whereas PMT1 and PMT2 said "…… can be through team-work, collaborative learning and student-centred approach to teach the iSTEM lesson. The participants were further interviewed about their preparedness to teach integrated STEM lesson.

All the six respondents had agreed that they are fully prepared to apply and teach the iSTEM lesson in their classroom instruction. However, before the iSTEM training, the participants had difficulties and did not have any orientation on how to teach iSTEM lesson, but now they had an improvement and feel relaxed and prepared to teach the iSTEM lesson and feel confident in applying integrated STEM strategies in the teaching instruction. Similarly, the participant PMT2 mentioned categorically that the iSTEM training gave them the opportunities to teach iSTEM lesson in a more holistic manner rather than in bit and pieces. Relatedly, PMT3 and PMT6 all mentioned application about the integration of STEM contents. Conclusively, the iSTEM training was found to have a positive impact on the PMTs in teaching the iSTEM course. This led to two categories that supported the PK, which included: using the iSTEM in teaching instruction and preparations for teaching the iSTEM lesson. Thematic Map for PK is illustrated in Figure 1 below.

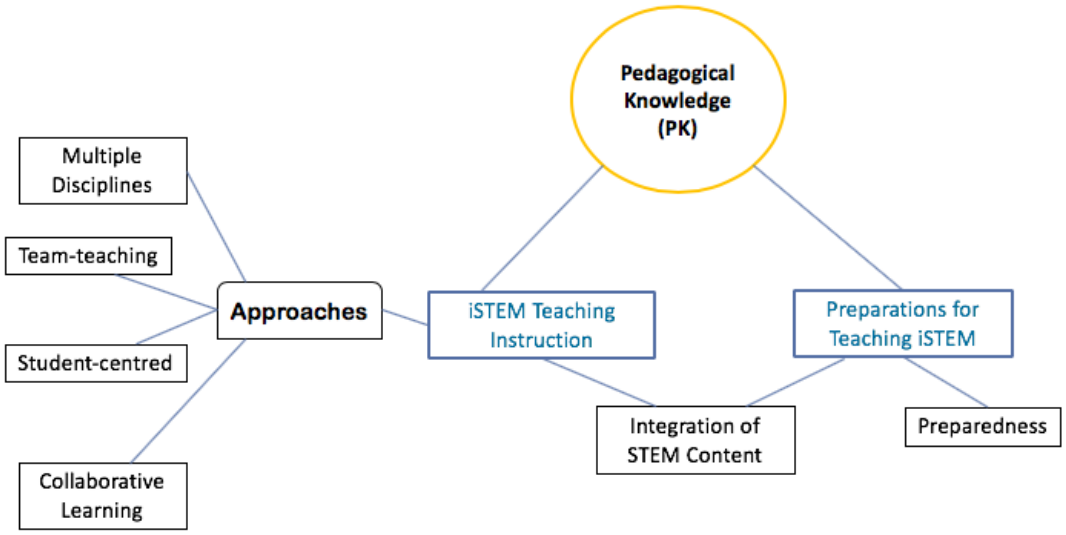

Figure 1: Thematic Map for PK

Figure 1 shows the thematic map for PK resulted from two different categories which comprised preparations for teaching iSTEM and iSTEM teaching instruction which were further collated from the identified codes. The different categories of PK were discussed more in details as:

Theme 1, Category 1: Using the iSTEM in Teaching Instruction

This category contains pedagogical knowledge practices that advocated into five approaches with different codes which includes integration of STEM content, connection of multiple STEM disciplines, team teaching, student-centred approach, and collaborative learning. Among these codes, integration of STEM content focuses on the connection of all the four STEM disciplines as mentioned by PMT4. Whereas, supporting the practice with implicit connections of the teaching instruction to the other disciplines. The participants, PMT3 and PMT6, mentioned Multiple disciplines as the teaching instruction that focus on the connection of mathematics, science and technology or engineering.

Theme 1, Category 2: Preparations for Teaching the iSTEM Lesson

This category contains two different codes which supported the participant's preparations for teaching the iSTEM lesson, which included preparedness and integration of STEM content for teaching the iSTEM lesson in their future classroom instruction. For the preparedness, all the participants indicated that they feel relaxed, satisfied and prepared to teach the iSTEM lesson. However,

advocating the practice with the connection of teaching the iSTEM lesson, participant PMT2 equally mentioned the integration of STEM content approach as the teaching of the iSTEM in a holistic manner rather than bit and pieces.

Interview Analysis on the CK for teaching the iSTEM Course

This interview session about the content knowledge for teaching the iSTEM course was conducted with the same focus group interviewees. In this regard, each of the member of the focus group was asked about his CK for teaching iSTEM, and they responded about their knowledge of science in which they stated that they had a good knowledge of science. They also, went ahead to explain science as the knowledge that usually concerned with the study of nature and the behaviour of natural things (PMT6). Mathematics as a tool for the understanding of science (PMT1; PMT3). Participants had explained that before receiving the training, they had difficulties in putting into action or in explaining more about their knowledge of science. Also, they mentioned their difficulties to integrate mathematics with engineering and or technology in teaching mathematics. But, now they had a positive view of knowing the relevance of science. Thus, the participants were further expressed their views regarding the field of science in which they were good at and they mentioned few subjects such as chemistry, physics and biology. For instance, PMT4 and PMT5 mentioned agricultural science and equally PMT5 include computer science as part of the science field. The researcher further moved to the next question whereby the participants were asked to give their contribution regarding integrating the knowledge mentioned in which they are good at in connection with mathematics. Hence, all the participants agreed that they could integrate their knowledge of science with mathematics. They all answered “yes”, and when they were asked to explain further, PMT4 specifically mentioned that both science and mathematics could be used in collecting, recording, organising data and communicating the results. Also, the participant PMT6 mentioned that both science and mathematics are closely related and the disciplines use time relationship, and they are both concerned with collecting and interpreting the data whereas PMT3 shows that both disciplines enhance learners’ motivation and their reasoning ability through the use of technology and hands-on activities in solving real-life problems. The participants were further interviewed about using technology in teaching will enhance the knowledge of mathematics.

Based on the interview results, the participants gave their views on using technology in teaching mathematics lessons in which PMT6 indicated the use of projector, computers and making PowerPoint presentation in teaching iSTEM course. Also, PMT3 mentioned the incorporation of multimedia, scientific and or graphing calculator in teaching iSTEM lessons. More so, most participants mentioned that the use of technology in teaching mathematics increases the learners' excitement and make the lesson interesting and fun. It is viewed that it makes the learning to be easy as mentioned by PMT5 in his response. Also, PMT2 added that it builds skills and engages the learners to work in a team. The participants were further interviewed to explain from their viewpoint the word "engineering" and also explained how they would integrate engineering in mathematics. Likewise, the participants were asked about the concept of "Engineering". They mentioned that it is a branch of science and technology that is concerned about the design, invention and building of materials needed to make human life easier. Consequently, when the participants were asked on how they would integrate engineering into mathematics, PMT4 mentioned that engineering could be incorporated through digital design that can be developed on a computer into a physical object to aid the teaching of mathematics. Likewise, PMT3 added that it could be through incorporating images in the teaching of vectors, basic statistics and matrices and matrix transformation and representation in the teaching of mathematics. Based on the responses obtained the participants after receiving the iSTEM training, it is indicated that their understanding about incorporating science, technology, and engineering in the teaching of iSTEM has been elicited.

The overview of the theme, category, sub-category and codes showing exploration of CK for teaching the iSTEM course were extracted, and similar codes mentioned by the participants were grouped. The theme indicated participants content knowledge to the actual knowledge of integrating mathematics content that the participants need to have for the teaching of the iSTEM course. This led to six categories that supported the CK as illustrated in the thematic map in Figure 2 below.

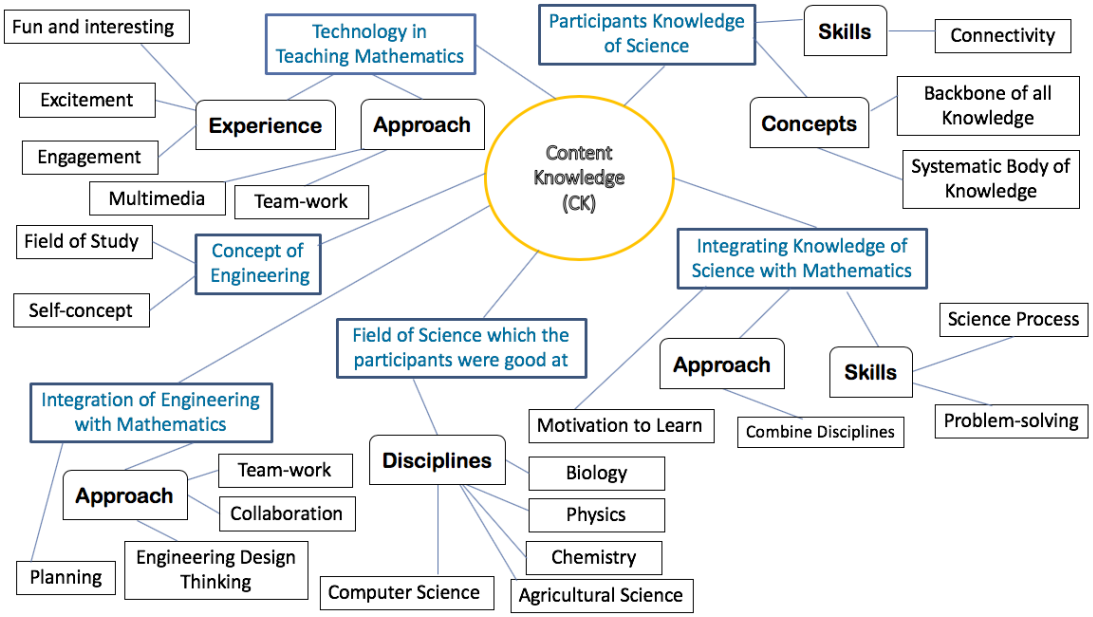

Figure 2: Thematic Map for CK

Figure 2 shows the thematic map for CK which resulted from six different categories which comprised participants knowledge of science, field of science which the participants were good at, integrating knowledge of science with mathematics, technology in teaching mathematics, concept of engineering and integration of engineering with mathematics which was further collated from the participants identified codes. The different categories of CK were discussed more in details as:

Theme 2, Category 1: Participants knowledge of Science

This category encompasses content knowledge practices that advocated into different codes which include conceptions of science as the backbone of all knowledge, systematic body of knowledge and connectivity. Among these codes, a systematic body of knowledge focus on the systematic way of modifying the natural world and also an organised body of knowledge as rightly mentioned by PMT1 and PMT4 relatedly. Also, advocating science as the backbone of all knowledge, PMT2 stated her understanding of science as is mostly concerned with the collection of facts to understand how the natural world works.

Theme 2, Category 2: Field of Science which the participants were good

This category contains five different science disciplines with codes supporting the participants' field of science which they were performing better. The five science disciplines mentioned includes

Biology; Chemistry; Physics; Computer Science; and Agricultural Science. Theme 2, category 3 is about integrating the knowledge of science with mathematics.

Theme 2, Category 3: Integrating Knowledge of Science with Mathematics

This category supported the content knowledge skills, and approaches that advocated into different codes which include science improves motivation to learning and reasoning ability, science improves problem-solving skills and science process using collection of data, recording, organising the data and communicating the results. Particular among these codes, motivation to learn enhances through the use of technology and hands-on activities as precisely mentioned by PMT1.

Theme 2, Category 4: Technology in Teaching Mathematics

This category (technology in teaching mathematics) incorporates content knowledge practices that advocated into five different codes for using technology in teaching mathematics comprised excitement, make teaching fun and interesting, engaging, team-work and use of multimedia. Among these codes, fun and interesting make the lesson more excited and enjoyable to the learners as exactly mentioned by most of the participants. Additionally, advocating on the code excitement, PMT1 and PMT4 mentioned that using technology in teaching makes learning easier and increase interest in the lesson. Moreover, PMT3 and PMT6 mentioned that using multimedia in teaching incorporated projector, scientific calculator and computers in making PowerPoint presentation.

Theme 2, Category 5: Concept of Engineering

This category expressed the view of the participants about their knowledge of engineering. These advocated into two different codes which included: Engineering is a field of study and a self-concept. Among these codes, the field of the study indicated that it is a branch of science and technology focused on the design, building and structures as rightly mentioned by PMT1; PMT5 and PMT6. Also, advocating on the code self-concept, most of the participants indicated their understanding of engineering as it is deeply rooted with the principles and rules of mathematics. Theme 2, category 6 below is about the integration of engineering with mathematics.

Theme 2, Category 6: Integration of Engineering with Mathematics

This category contains four different codes supported the participants' approach and the ability for team-work, engineering design thinking, planning and collaboration. For the team-work, most of the participants indicated that team-work enables the learners to participate as a contributing member of the group (PMT1; PMT3; PMT5). However, advocating the practice with the connection of teaching the iSTEM lesson, participant equally mentioned engineering design thinking as a knowledge designed through construction and dynamics using principles of mathematics. Nonetheless, planning through brainstorming and development of multiple solutions was indicated by PMT2. Whereas, collaboration signifies the ability to make effective communication of ideas among the peers as rightly mentioned by the participants (PMT2; PMT4; PMT6). In a nutshell, the foregoing has explained the overall findings of the study.

Discussions

The prime objective of this study was to investigate how the iSTEM training can improve the PK and CK of PMTs in the teaching of iSTEM course. The PMTs PCK in teaching iSTEM was described based on the area of pedagogical knowledge and content knowledge for teaching the iSTEM course. The sub-section below discusses of the overall findings relating to pedagogical knowledge of the PMTs for teaching the iSTEM course after the iSTEM course training.

Pedagogical Knowledge of PMTs for Teaching iSTEM Course

Pedagogical knowledge is the act of teaching, training and instruction (Hartati *et al.*, 2019) it also includes educational objectives, teaching and learning processes, knowledge of the approaches or procedures used in the classroom, the essence of the target audience and the awareness evaluation strategies (Norton, 2019). The findings of this study indicated that participants agreed that the iSTEM course training helped them improved positively on how they might use their knowledge of pedagogy in teaching iSTEM in their future classroom instruction. This idea of pedagogy in teaching the iSTEM course is fundamental for an effective retrospective teaching. This idea concurred with the Shulman (1986) explanations which gave the impression that an acceptable description of the forms of knowledge the teachers possessed must accomplish to carry out the teaching job over the iSTEM education. In as far as the iSTEM teaching is

concerned, O'neill *et al.* (2012) outline three components that support STEM pedagogical development practices in their classroom: First of all, teachers must be willing to leave their comfort zone in their current teaching methodologies. Secondly, teachers can not completely change their practices without guidance. Thirdly, students are already trained to learn in a certain way; therefore, STEM teachers must promote new ways of learning and think through real-world problems that create meaningful connections.

The findings also revealed that engaging the pedagogy of learners in engineering content by bridging mathematics and science disciplines as to how they would use integrated STEM in their teaching instruction (Frykholm & Glasson, 2005; Furner & Kumar, 2007). Moreover, the study of Stohlmann *et al.* (2012) and Breiner *et al.* (2012) found that connecting all the four STEM disciplines in one lesson to solve a real-life problem is paramount. Consequently, Okpala (2012) pointed out that, STEM instruction is a meta-discipline which indicated the formation of a discipline that placed the integration of other STEM fields of knowledge into a recent whole rather than in pieces and bits. Likewise, STEM Education is defined as an interdisciplinary strategy to curriculum and instruction by integrating the four fields of study into one cohesive teaching strategies design for the removal of common boundaries and roadblock that stands between the STEM disciplines as literature contends (Friedow *et al.*, 2012; Morrison, 2006; Morrison & Bartlett, 2009; Tsupros *et al.*, 2009). STEM education is a strategy to education which integrates the four disciplines cohesively through an instructional method which utilizes strategies that investigated and explain the teaching and learning between or among more than two of the STEM disciplines, and between STEM disciplines and one or more additional school subjects (Sanders, 2009).

It is also evident from this study that the participants had agreed that they are prepared to apply and teach the iSTEM lesson into their future classroom instruction. The participants further explained that before the iSTEM course training they did not have any orientation on how to teach iSTEM course but after the training, they had a positive improvement and feel relaxed and prepared to teach iSTEM course. This finding concurred with the study of Magnusson *et al.* (1999) that orientation is a general way of seeing or conceptualising the teaching of science and mathematics. The finding added that the participants are ready in applying the iSTEM pedagogy in their future classroom instruction. The participants mentioned categorically that the iSTEM

course training gave them the opportunities to teach the iSTEM in a holistic manner rather than in bit and pieces. In the same vein, Okpala (2012) remarked that integration of STEM is an interdisciplinary approach for learning by combining the four disciplines together into one interrelated teaching and learning paradigm, the creation of a discipline placed on the integration of other discipline knowledge into a new indivisible ' whole' rather than in pieces and bits.

The present study also found that the iSTEM teaching instruction can be through team-work, collaborative learning and student-centred approach. These findings are in concordance with the recommendation of Nikirk (2012) that the STEM pedagogical strategies that help the iSTEM teachers to teach and facilitate student learning effectively are through displaying the graphs, students react and learn from visual elements (images, graphics and video) more quickly than reading materials in text format. Findings from this study highlighted the iSTEM course training has successfully improved the PK of PMTs in teaching iSTEM.

Content Knowledge for teaching iSTEM Course

Content knowledge for teaching iSTEM course refers to the development of a deep understanding of mathematics and science knowledge that the PMTs need to have for teaching iSTEM course. Categorically, most participants mentioned that the use of technology in teaching mathematics increases the learners' excitement and make the lesson interesting and fun and make the learning to be easy. To ensure that teachers are successful, they must receive support for developing their content knowledge to be able to effectively teach integrated STEM (Stohlmann *et al.*, 2012; Yıldırım & Sidekli, 2018).

The findings revealed that both the science and mathematics are closely related and the disciplines improve learners' motivation and their reasoning ability through the use of technology and hands-on activities in solving real-life problems. With regard to knowledge of content, pre-service STEM education teachers are considered to be effective in the classroom if they understand their content knowledge deeply and grasp procedures and concepts from different perspectives (Ejiwale, 2012; Halim *et al.*, 2014). Thus, this has been justified by the teachers level of knowledge and understanding of content limited to their capability to teach the content effectively as literature posits (Nadelson *et al.*, 2012). However, content knowledge alone is not sufficient, but expertise related to it is also important for teaching

iSTEM. Conclusively, from the responses obtained from the participants after receiving the iSTEM course training, indicated their understanding about incorporating science, technology, and engineering in the teaching of mathematics content.

Conclusion and Recommendation

The study concluded that the iSTEM helps the PMTs to improved positively on how they would use their PK in teaching iSTEM in more holistic manner rather than in bit and pieces in their future classroom instruction using team-work, collaborative learning and student-centred approach. Also, the study was designed to transformed the current curriculum in Nigeria from receiving teaching of separate STEM disciplines to integrated STEM-based practices. It is recommended that conferences, workshops, and seminars should be organised for the PMTs to update their skill in the application of iSTEM strategy. Also, a similar study should be conducted in all level of education as the importance attached towards the iSTEM education globally.

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Rima International Journal of Education (RIJE), Vol. 3 (No. 3): Nov 2024; P: 174-174 ISSN: 2756 - 6749

Service Learning in 21st Century: The Role of Emerging Technologies on Today's Preservice Teacher Education

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Abstract

This study explores the integration of emerging technologies in service learning within preservice teacher education, highlighting its significance in preparing future educators for the demands of 21st-century classrooms. Service learning, which combines academic learning with community engagement, is examined as a powerful pedagogical approach that fosters critical thinking, cultural competence, and social responsibility. The research identifies various emerging technologies, such as virtual reality, artificial intelligence, and collaborative online platforms that enhance the service-learning experience by facilitating access to resources, promoting communication, and enabling innovative pedagogical practices. However, the study also addresses challenges faced by preservice teachers, including inadequate institutional support, ethical concerns regarding data privacy, and the rapid evolution of technology. The study discusses the importance of a collaborative effort among educators, institutions, and technology developers to create a robust framework for service learning that influences technology effectively, thereby enriching teacher education and fostering a more equitable educational landscape for all students.

Keywords: Service Learning, Emerging Technologies, Preservice Teacher Education, Community Engagement, Pedagogical Practices

Introduction

In the 21st century, the evolving landscape of education necessitates innovative approaches to teacher preparation, particularly for preservice teachers. Service learning, a pedagogical approach that integrates community engagement with academic learning, has gained significant traction as a means of equipping future educators with practical skills, cultural competence, and a commitment to social responsibility (Billig, 2017). This blend of experiential learning and civic participation aligns seamlessly with the demands of modern education, where fostering critical thinking, adaptability, and empathy are paramount.

However, as the world becomes increasingly digital, the integration of emerging technologies into service learning has the potential to

redefine its scope and impact. Technological advancements—ranging from virtual reality (VR) and artificial intelligence (AI) to collaborative platforms and data analytics—offer unique opportunities to enhance the service-learning experience for preservice teachers. These technologies not only broaden the accessibility and inclusivity of such programs but also equip future educators with the digital literacy skills required to thrive in today's classrooms (Copur-Gencturk et al., 2023).

In today's fast-evolving educational settings, figuring out how to utilise new technologies to improve service learning is more than just an academic task; it's an essential pursuit. This research adds to the ongoing conversation about reforming teacher education, providing valuable insights into how technology-enhanced service learning can serve as a foundation for cultivating skilled, culturally sensitive, and future-ready educators.

Emerging Technologies for classroom Instruction in 21st Century

The rapid evolution of technology in recent decades has profoundly reshaped education, offering new opportunities for both teaching and learning (Gomez et al., 2021; Tunjera & Chigona, 2020). Emerging technologies are now at the forefront of transforming the traditional classroom into dynamic, interactive, and personalized learning environments. As we progress further into the 21st century, educators are increasingly integrating new tools that enhance student engagement, foster collaboration, and promote critical thinking skills.

Emerging technologies for education refer to innovative technological tools, systems, and platforms that are transforming the way teaching and learning occur in classrooms and other educational settings (Kerimbayev et al., 2023). These technologies are reshaping the traditional educational experience by enhancing access to learning, promoting engagement, fostering personalized education, and expanding new possibilities for students and educators alike. As educational institutions and learners increasingly embrace these advancements, emerging technologies are playing a key role in making education more interactive, accessible, and effective.

According to Gomez et al. (2021), the integration of emerging technologies into classroom instruction is profoundly reshaping the educational landscape in the 21st century. These technologies—ranging from Artificial Intelligence (AI) and Virtual Reality (VR) to

gamification and cloud computing—are transforming teaching methods and student learning experiences. One major implication is personalized learning, where AI systems analyze student data to tailor lessons, offering customized support for diverse learning needs. This can help close achievement gaps by addressing individual strengths and weaknesses.

Additionally, collaborative learning is enhanced through tools like cloud-based platforms and interactive technologies. Students can collaborate in real-time, share resources, and engage with peers globally, fostering teamwork and communication skills critical for the digital age (Kerimbayev et al., 2023). Immersive technologies like VR and AR bring abstract concepts to life, offering students experiential learning opportunities that deepen understanding and retention (Majewska & Vereen, 2023).

However, these advancements also raise challenges, such as the need for digital literacy among both educators and students, and concerns about equity in access to technology (Du & Meier, 2023). Teachers must adapt to new tools and integrate them effectively, which requires ongoing professional development. Despite these challenges, the potential of emerging technologies to enhance engagement, improve learning outcomes, and prepare students for future careers makes their role in modern classrooms essential. Some examples of emerging technologies in education include:

1. Artificial Intelligence (AI) and Machine Learning

Artificial intelligence (AI) is one of the most influential technologies in education today. According to (Kamalov & Gurrib, 2023), AI systems can personalize learning experiences for students by analyzing their performance and adapting content to suit individual needs. This is especially beneficial for creating differentiated learning environments, where students with varying learning speeds or styles can receive customized lessons.

For example, AI-powered tutoring systems can provide real-time feedback and help students work through problems in subjects like mathematics or language arts. AI can also assist teachers by automating administrative tasks such as grading, lesson planning, and identifying students who may need additional support. In this way, teachers are able to focus more on direct instruction and student interaction.

Machine learning, a subset of AI, enables systems to predict and recommend resources, exercises, and materials based on student behavior (Kamalov et al., 2023). This helps students engage with content that aligns with their interests or challenges, promoting a more individualized and interactive learning experience (Gligorea et al., 2023).

2. Virtual Reality (VR) and Augmented Reality (AR)

Virtual Reality (VR) and Augmented Reality (AR) are immersive technologies that are revolutionizing the way students experience learning (Ahmad et al., 2023), in the following manner:

- Virtual Reality (VR) creates entirely digital environments where students can engage in simulations that would be impossible or unsafe in the real world (Motejlek & Alpay, 2021). For example, VR can transport students to historical events, remote ecosystems, or the inside of a cell, offering a fully immersive experience that enhances learning retention. In subjects like science, history, and art, VR allows for experiential learning that is often more engaging and impactful than traditional methods.

- Augmented Reality (AR) overlays digital information onto the real world, enhancing students' interaction with physical objects (Cao & Yu, 2023). In classrooms, AR applications can bring static textbooks to life by displaying interactive 3D models, maps, or videos on the page when viewed through an AR-enabled device. For example, AR could be used to create interactive biology lessons where students can view and manipulate the internal structure of a plant or animal in 3D, making abstract concepts easier to grasp.

Both VR and AR provide opportunities for students to learn through discovery, exploration, and immersive engagement, fostering higher-order thinking skills like analysis, synthesis, and evaluation.

3. Gamification and Game-Based Learning

Gamification involves the application of game mechanics—such as points, levels, and rewards—into educational settings to enhance motivation and engagement (Zainuddin et al., 2020; Rahman et al., 2018). Game-based learning (GBL) goes further, integrating actual games into the learning process to teach content and develop skills (Demirbilek et al., 2022).

According to Sharmin et al. (2023), games, whether digital or physical, encourage students to solve problems, make decisions, and collaborate with peers in a fun, low-risk environment. For example, educational platforms like Kahoot! and Quizizz use quizzes and games to reinforce concepts in subjects like math, science, and history. Likewise, Minecraft Education Edition allows students to build and explore virtual worlds while learning everything from architecture and engineering to history and coding. Moreover, Silva et al. (2017), assert that the intrinsic motivation generated by these games can help students develop persistence, teamwork, and problem-solving skills, all while making learning enjoyable. Teachers can create more engaging, interactive, and dynamic classrooms by integrating gamification and game-based learning.

4. Cloud Computing and Collaborative Tools

Cloud computing has become indispensable for modern education, providing access to a wide range of tools, platforms, and resources that facilitate learning anywhere, anytime. Through cloud-based platforms like Google Classroom, Microsoft Teams, and Edmodo, students and teachers can collaborate seamlessly on assignments, share resources, and access learning materials from any device with an internet connection (Monika et al., 2023; Sari et al., 2021).

Cloud computing also enables real-time feedback, document sharing, and collaboration on projects, which fosters a cooperative learning environment (Wu, 2019; Çakıroğlu & Erdemir, 2018). Collaborative tools such as Google Docs, Padlet, and Trello help students work together on group assignments, enhancing communication skills, teamwork, and accountability. Moreover, cloud computing enables the storage and sharing of vast amounts of educational content, such as lesson plans, instructional videos, and interactive simulations, creating an easily accessible, centralized hub for learning materials (Al-Samarraie & Saeed, 2018).

5. Learning Analytics and Data-Driven Instruction

Learning analytics refers to the collection and analysis of data from student interactions with learning platforms, assignments, and assessments to gain insights into their progress, behavior, and engagement (Caspari-Sadeghi, 2022). If data could be utilized effectively, teachers can identify patterns and trends, allowing them to make informed decisions about instruction, intervention, and curriculum development.

Emerging technologies in the classroom are reshaping education in the 21st century, allowing for more personalized, engaging, and interactive learning experiences. With AI-driven adaptive learning systems, immersive VR environments, and collaborative cloud platforms, these innovations are improving how students learn and how teachers instruct. As these technologies advance, they promise to further transform education, making it more accessible, inclusive, and dynamic than ever, particularly in the training of preservice teachers.

6. Internet of Things (IoT) and Smart Classrooms

The Internet of Things (IoT) refers to the network of interconnected devices that communicate and share data (Altwoyan & Alsukayti, 2022; Qi-chao, 2022). In education, IoT is transforming classrooms into smart environments that enhance learning and teaching. For example, IoT-enabled devices can track student attendance, monitor classroom temperature and lighting, and provide real-time data on classroom engagement through smart whiteboards and interactive displays. Sensors and smart devices can also assist in creating a more inclusive classroom by supporting students with disabilities through adaptive technology (e.g., voice recognition software, smart hearing aids, or tactile learning devices). The integration of IoT in classrooms provides a seamless learning environment where teachers can manage classroom logistics and tailor learning experiences to individual student needs more efficiently.

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Preservice Teachers' Experience in Traditional Settings

Preservice undergraduate teachers are embarking on a pivotal journey towards becoming educators who will shape the minds and futures of countless students. This stage of their professional development is marked by rigorous coursework, hands-on experiences, and a plethora of opportunities for growth and reflection (Low, 2023; Yuan & Yang, 2020). As they delve into educational theories, pedagogy, and the diverse needs of learners, these future teachers are not just absorbing

information; they are also developing critical thinking skills and a framework for effective teaching practices (Benedicto & Andrade, 2022).

According to Ludwikowska (2019), collaboration plays a crucial role in their training, whether through peer group projects, mentoring relationships, or field placements in real classrooms. These interactions expose preservice teachers to various teaching styles and classroom management techniques, allowing them to curate their own approach to education. It is within this vibrant community that they learn the value of feedback, adaptability, and resilience—essential traits for any successful educator. Additionally, technology integration has become an indispensable facet of modern teaching, and preservice teachers are encouraged to harness innovative tools and resources (Cao et al., 2023). If teachers focus on exploring digital strategies and blended learning environments, they are better equipped to engage the digital-native generation of students, fostering an inclusive learning atmosphere that responds to varied interests and learning modalities.

Generally, the preparation of preservice undergraduate teachers is about more than mastering content; it is about shaping their identities as reflective practitioners and advocates for equity in education. Their experience is one of constant evolution, a blend of theory and practice that empowers them to approach the profession with passion, creativity, and an unwavering commitment to fostering a love of learning in their future classrooms (Becton et al., 2020).

Service-Learning Experiences for Preservice Undergraduate Teachers

Service learning is an educational approach that combines learning objectives with community service to provide a pragmatic, real-world experience (Lavery et al., 2017). It involves students engaging in projects or activities that address real-world issues while applying what they are learning in the classroom to those issues. Service learning is typically structured around the idea that students can achieve academic, personal, and civic growth by participating in service to their communities. The concept emphasizes a reciprocal relationship where students apply academic knowledge to address community needs, while also reflecting on the service experience to deepen their understanding of course content (Rochford, 2013). This pedagogical strategy not only enhances students' academic learning but also fosters a sense of civic responsibility and social awareness (Bringle & Clayton, 2021). Service learning is often structured in a

way that encourages students to actively engage with the community, participate in meaningful projects, and gain a deeper appreciation for diverse perspectives (Griffith & Zhang, 2013).

According to (Said et al., 2015), key feature of service learning is its focus on reflection. Students are typically required to reflect on their service experiences, both individually and in group discussions, to analyze how the service connects to their academic studies and personal growth. Reflection helps students internalize the lessons learned from their engagement, encouraging them to consider how their academic knowledge can be used to address real-world issues (Rogers et al., 2019). This process also aids in developing critical thinking, problem-solving, and communication skills, which are valuable both in academic and professional settings.

Beyond academic benefits, service learning also promotes community engagement and social responsibility (Schelbe et al., 2014). When working directly with community members, students contribute to positive social change, often in areas such as education, healthcare, environmental sustainability, or social justice. This fosters a sense of empathy and encourages students to be active participants in society (Wu et al., 2022). In turn, communities benefit from the support of students who bring fresh perspectives and enthusiasm to local projects. Ultimately, service learning creates a mutually beneficial relationship between students and the communities they serve, enhancing both individual and collective growth.

Consequently, according to (Norman, 2018), service learning offers significant implications for the experiences of preservice undergraduate students—those who are preparing to become future educators. When integrating community service with academic coursework, service learning provides a unique opportunity for these students to deepen their understanding of teaching, develop professional skills, and engage with the broader community. Thus, some of the crucial implications of service learning on preservice undergraduate students' experience include:

1. Development of Teaching Skills

Service learning allows preservice teachers to apply the theoretical knowledge they acquire in the classroom to real-world teaching situations (Lavery et al., 2017; Said et al., 2015). This hands-on experience enhances their teaching abilities, helping them understand how to manage diverse classrooms, communicate effectively with

students, and adapt to different learning needs. Working directly with students, especially in underserved or diverse communities, enables preservice teachers to experiment with various teaching strategies and gain confidence in their ability to teach (Cavendish et al., 2020; Sanger, 2020).

For instance, preservice teachers might work in after-school programs, tutoring students, or helping to develop educational activities. These experiences provide opportunities to observe classroom dynamics, engage in lesson planning, and implement instructional strategies in real-life settings, all of which are crucial for their professional development.

2. Improved Reflection and Critical Thinking

Service learning encourages students to reflect on their experiences, helping them connect academic knowledge with practical application (Lin, 2021). For preservice teachers, this reflective practice is particularly valuable because it fosters critical thinking about teaching methods, the challenges they face in the classroom, and the effectiveness of their interactions with students.

According to (Brown et al., 2020), at the time of reflecting on their community service experiences, preservice teachers develop a deeper understanding of the social and emotional needs of their future students. This reflection also allows them to evaluate their personal growth and teaching strategies, which can lead to more intentional and thoughtful decision-making in their future careers.

3. Increased Cultural Competence

As disclosed by (Borgerding & Caniglia, 2017), one of the most important benefits of service learning for preservice teachers is the opportunity to engage with diverse communities. Whether working in urban, rural, or economically disadvantaged areas, students have the chance to interact with individuals from different cultural, socioeconomic, and linguistic backgrounds. This experience helps preservice teachers build cultural competence, which is critical in today's increasingly diverse classrooms.

Moreover, Afifah & Wirza (2021), also believe that when working in these communities, preservice teachers gain firsthand insight into the challenges that students from different backgrounds face. They learn to appreciate the importance of culturally responsive teaching, which

can lead to more inclusive and equitable teaching practices. Additionally, they become better equipped to recognize and address issues related to diversity, equity, and inclusion in their future classrooms (Darling-Hammond et al., 2024).

4. Enhanced Professionalism and Work Ethic

As suggested by Andrews & Richmond (2019), engaging in service learning helps preservice students develop a strong sense of professionalism, responsibility, and work ethic. Through their service activities, students learn the importance of punctuality, commitment, teamwork, and communication, all of which are key qualities for future educators (Norman, 2018). These professional habits are reinforced by real-world expectations in the service setting, where preservice teachers may need to collaborate with other educators, parents, and community members, often under challenging conditions. This hands-on experience also cultivates leadership skills as preservice teachers take initiative, problem-solve, and make decisions about how best to meet the needs of the students or community members they are serving.

5. Strengthened Commitment to Social Justice and Civic Responsibility

According to Reames et al. (2020), service learning encourages preservice teachers to recognize their role as active citizens who can contribute to social change. It exposes them to social issues such as poverty, inequality, and educational disparities, and fosters a sense of civic responsibility and a commitment to social justice. In this case, Yuan (2017), observed that when directly addressing community needs, preservice teachers develop an understanding of the broader social context in which education operates. This experience often deepens their passion for teaching and motivates them to advocate for underrepresented or marginalized groups. Many preservice teachers come to see their future work not just as an educational endeavor but as part of a broader movement to improve social conditions through education.

6. Building Stronger Community Connections

Service learning fosters a strong sense of connection between preservice students and the communities they serve (Dirksen, 2020). Some authors like Hildenbrand & Schultz (2015) believed that by actively participating in community development or educational

outreach projects, preservice teachers gain a sense of belonging and social responsibility. This builds bridges between the academic world and the communities where students will eventually work as professionals. These experiences often result in long-term collaborations between schools and community groups, which continues to benefit both students and the areas they help. Preservice teachers also build valuable support networks that can boost their careers down the road.

7. Improved Career Readiness and Employability

According to Weatherby-Fell et al. (2019), service learning helps preservice teachers develop a range of practical skills that increase their employability. It enhances their resumes by demonstrating initiative, leadership, and real-world experience. Employers in education value candidates who have experience working with diverse groups of students and have demonstrated the ability to solve problems, collaborate with colleagues, and engage in reflective practice. Additionally, service learning provides opportunities for preservice teachers to build professional relationships and gain mentoring from experienced educators, which can lead to future job opportunities or references (Lavery et al., 2017).

The Role of Emerging Technologies in Service-Learning Experiences

Service learning, which combines academic education with community service, has been acknowledged for its effectiveness in promoting critical thinking, civic responsibility, and practical skills among students (Gibson & Sandifer, 2020). According to Haines & McClure (2020), emerging technologies have become increasingly important in changing the service-learning experience, particularly for preservice teachers. These technologies, including digital platforms, social media, virtual classrooms, and artificial intelligence, are altering the ways students interact with their learning, work with communities, and reflect on their experiences (García-Martínez et al., 2023).

1. Enhancing Access to Resources and Learning Materials

Emerging technologies allow students to access a broader range of educational resources, bridging the divide between traditional classroom learning and real-world experiences (Koehler & Vilarinho-Pereira, 2021). For preservice teachers, having access to digital

libraries, educational apps, and online databases significantly improves their ability to research and plan their service learning projects. These tools also familiarise them with a variety of pedagogical strategies and best practices that they can apply in real teaching environments, making them more innovative and resourceful (Figuccio, 2020; Ngai et al., 2023).

Preservice teachers can utilise online platforms such as Google Classroom or various learning management systems (LMS) to share teaching resources, participate in discussions with mentors, and obtain feedback on their community projects. This approach allows them to handle their service learning more effectively, even in remote or varied environments, ensuring that students can engage in meaningful ways regardless of geographical or infrastructural challenges (Weitl-Harms, 2024).

2. Facilitating Collaboration and Communication

Emerging technologies, particularly social media and collaborative tools like Slack, Zoom, or Microsoft Teams, are central to fostering communication and collaboration in service-learning projects (Regmi, 2024). These tools let future teachers link up with classmates, advisors, and community members, building a support network that goes beyond the actual classroom. Online meetings and shared work spaces help students exchange thoughts, solve problems, and think about their experiences as they happen (Trust et al., 2016).

Furthermore, people in the community who live far away or can't get to in-person meetings can still take part in service-learning projects using technology. This leads to community involvement that includes more people from different backgrounds. For example, teachers-in-training might use social media to push educational campaigns, work together on digital storytelling projects, or connect with local communities through online workshops or webinars.

3. Personalizing and Enhancing Learning Experiences

According to Regmi (2024), technologies like adaptive learning platforms and artificial intelligence (AI) have the potential to personalise the learning experience for preservice teachers engaged in service learning. These tools can provide tailored feedback based on students' progress and needs, helping them refine their teaching strategies and approaches. AI-powered tutoring systems, for example, can help preservice teachers simulate classroom scenarios, practice

lesson delivery, or receive instant feedback on teaching performance (Maity & Deroy, 2024).

However, technologies such as virtual reality (VR) and augmented reality (AR) provide immersive learning experiences that replicate real-world classroom settings or community environments. Preservice teachers can practice their teaching skills in virtual classrooms before interacting with actual students or face the challenges of working in underserved communities without stepping off campus. These immersive tools foster empathy, improve problem-solving abilities, and enrich students' comprehension of various learning environments (Ng, 2021).

4. Promoting Reflection and Critical Thinking

Emerging technologies significantly contribute to fostering reflection and critical thinking, essential elements of the service-learning process (Ng, 2021). Digital platforms like blogs, podcasts, and video journals enable preservice teachers to capture their experiences, contemplate challenges, and evaluate their personal development. These tools not only create a venue for self-expression but also present chances for valuable feedback from peers and instructors.

The opportunity to revisit and refine reflections through digital media enables preservice teachers to gain a deeper understanding of their teaching methods and how to enhance their interactions with students and communities. Moreover, these reflective practices are vital for cultivating a lifelong learning mindset, which is essential in the ever-evolving field of education. New technologies are transforming the service learning landscape by creating fresh opportunities for engagement, collaboration, and reflection (Bringle et al., 2022). For preservice teachers, these tools provide significant advantages to enrich their learning experiences, develop crucial skills, and equip them for the varied challenges present in today's classrooms and communities.

Challenges Preservice Teachers May Face When Using Emerging Technologies for Service Learning and How to Overcome the Challenge

Incorporating emerging technologies into service learning provides many opportunities for preservice teachers, but it also brings several challenges that can affect their effectiveness and engagement (Luan et al., 2020). These challenges arise from technical, pedagogical, and

systemic issues that need to be tackled to fully realize the advantages of technology-enhanced service learning.

1. Lack of Digital Literacy

Preservice teachers often vary in their familiarity with emerging technologies such as virtual reality (VR), augmented reality (AR), and artificial intelligence (AI)-powered tools. While some may be adept at using basic educational software, others may struggle to use advanced technologies effectively. This disparity can lead to frustration, reduced confidence, and a lack of engagement in service learning projects. For example, a preservice teacher using AR for community history lessons might struggle to create immersive experiences due to limited technical know-how. These problems can be solved by coming up with structured training programs that focus on building foundational digital literacy and providing hands-on experience with specific tools (Tınmaz et al., 2022).

2. Technical Barriers

Emerging technologies typically depend on dependable hardware, software, and internet access. Unfortunately, many service-learning environments, particularly in underserved communities, do not have the necessary infrastructure to support these technologies. Preservice teachers may encounter obstacles like software compatibility problems, hardware malfunctions, or insufficient bandwidth. For instance, a VR tool designed for virtual classroom simulations might not operate effectively because of outdated hardware in the service-learning setting. This issue can be addressed by promoting the use of low-tech alternatives and ensuring access to mobile-compatible tools that can work in resource-limited environments (Gallegos et al., 2022).

3. Limited Time and Resources

Preservice teachers frequently find it challenging to juggle their coursework, fieldwork, and the learning curve associated with new technologies. Service learning requires a considerable amount of effort to plan and implement community-based projects, and incorporating emerging technologies can further heighten the stress of their workload. For example, a preservice teacher may face difficulties in integrating AI-based assessment tools while also handling their teaching duties. To address this challenge, educators should focus on streamlining the integration process by choosing user-friendly

technologies and offering continuous support throughout the service-learning program (Gligorea et al., 2023).

4. Resistance to Change

Some preservice teachers may be reluctant to embrace new technologies due to fears of failure or a preference for conventional teaching methods. This resistance can arise from a lack of confidence in their ability to adapt to new tools or skepticism about the role of technology in enhancing meaningful learning experiences. For example, a preservice teacher might favor traditional group discussions over digital collaborative tools, thinking that technology undermines personal interaction. To overcome this challenge, educators should focus on demonstrating the effectiveness of these tools through success stories, mentorship, and peer collaboration to build trust and acceptance (Regmi, 2024).

5. Pedagogical Misalignment

Emerging technologies hold great potential, but their success hinges on their alignment with educational goals. Preservice teachers often find it challenging to incorporate these tools effectively into their service-learning projects, resulting in technology use that may seem disconnected or superficial. For instance, implementing gamification in a community literacy program could divert attention from the primary learning objectives if not properly aligned. This challenge can be tackled by offering clear guidelines and examples that demonstrate how to use technologies in ways that support pedagogical aims and boost engagement (Crow & Henning, 2021).

6. Challenges in creating an environment where everyone feels valued and included

Service-learning environments typically include a variety of learners, each with unique needs. However, emerging technologies can sometimes unintentionally leave out certain groups, like individuals with disabilities or those who do not have access to devices. Preservice teachers must address these equity issues while making sure that technology is used in an inclusive manner. For example, a digital storytelling tool may not be usable for students with visual impairments in a community learning program. It is essential for teachers to select technologies that come with accessibility features and to modify activities to accommodate the diverse needs of their learners (Yiğit, 2020).

7. Inadequate support from the Institution

Preservice teachers rely heavily on guidance and resources from their institutions. Inadequate institutional support, such as limited access to training, mentorship, or funding for emerging technology tools, can hinder their ability to effectively integrate these technologies into service-learning projects. For instance, a lack of training on how to use collaborative tools like Google Classroom might leave preservice teachers unprepared for tech-based service learning. Institutions can provide professional development opportunities, access to resources, and partnerships with technology providers to facilitate better preparation (Henukh & Astra, 2021).

8. Ethical and Privacy Concerns

Using emerging technologies frequently entails the collection and management of data, which brings up ethical issues related to privacy and consent. Preservice teachers may find themselves ill-equipped to manage sensitive information in a responsible manner, particularly in community-based service-learning environments. For instance, a teacher utilizing AI-driven platforms for community assessments could encounter difficulties in guaranteeing that the data of participants is handled ethically. This challenge can be mitigated through training focused on data privacy laws, ethical standards, and the responsible use of technology.

9. Technocentrism

A common pitfall when integrating emerging technologies is placing too much emphasis on the tools instead of the learning outcomes. Preservice teachers might concentrate excessively on mastering the technology, which can overshadow the creation of meaningful, reflective service-learning experiences. For instance, if too much time is spent on setting up VR simulations, it may take away from building deeper connections within the community. This issue can be mitigated by promoting a balanced approach where technology acts as a facilitator rather than the main focus of the service-learning activity.

10. Accelerating technological evolution

Emerging technologies change rapidly, and preservice teachers often find it difficult to stay updated with the latest tools and updates. This challenge is made even more complex by the necessity to adjust their teaching methods to effectively integrate these new technologies. For

example, a preservice teacher may dedicate time to mastering a particular tool, only to find it has become outdated or has been succeeded by a newer version. To tackle this issue, it's important to encourage adaptability and offer continuous training opportunities to remain informed about technological advancements.

The difficulties that preservice teachers encounter when trying to incorporate new technologies into service learning are complex and involve various aspects, including technical skills, teaching methods, and systemic issues. Tackling these challenges calls for a well-rounded strategy that includes specialized training, support from institutions, and an emphasis on inclusivity and ethical considerations. Preservice teachers can fully harness the power of technology to improve their service-learning experiences and better equip themselves for the evolving needs of 21st-century classrooms by addressing these obstacles.

Conclusion

The study highlights the transformative potential of integrating emerging technologies into preservice teacher education. As the educational landscape evolves, the incorporation of innovative tools such as virtual reality, artificial intelligence, and collaborative online platforms not only enhances the service-learning experience but also prepares future educators to navigate the complexities of modern classrooms. These technologies facilitate immersive learning experiences, allowing preservice teachers to engage with diverse communities and develop essential skills in real-world contexts. Moreover, the study highlights the critical role of service learning in fostering cultural competence and social responsibility among preservice teachers. This experiential learning approach not only enriches their pedagogical practices but also empowers them to become advocates for equity and inclusion in education. Finally, the study calls for a collaborative effort among educators, policymakers, and technology developers to create a robust framework for service learning that embraces innovation.

Recommendation

I. Future studies should emphasize the pedagogical strategies that accompany the use of emerging technologies in service learning.

II. It is essential to create comprehensive ethical guidelines and training for preservice teachers regarding data privacy and

responsible technology use in service learning. Future research should address these ethical considerations more thoroughly, ensuring that educators are well-prepared to handle sensitive information responsibly.

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ISSN: 2756 - 6749