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Original Research Article

Leveraging STEM Education Using Multi-Functional-Mobile-Laboratory Intervention in the Midst of Banditry Activities: Implications for Skills Acquisition in Zamfara State, Nigeria

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Abstract

The inadequate supply of educational teaching aids and truly functional laboratories to aid teaching and learning of sciences across Nigeria, particularly Zamfara State, due to high cost incurred in acquiring them has necessitated the invention of a multifunctional mobile teaching aid and intervention laboratory for schools. The invention is a home-grown, purpose-built game changer to positively leverage the educational sector to enhance quality and effective Science, Technology. Engineering and Mathematics (STEM) education in Nigeria. Thus, the article x-rays banditry activities in Zamfara State and feasibility of integrating mobile-laboratory-intervention for skills acquisition in Zamfara State. The study adopted a mixed method research design using both qualitative and quantitative data. Four research questions and hypotheses were formulated to guide the study. The population consisted of 280 principals selected from three educational zones in Zamfara State using multi-stage sampling technique. A self-designed instrument was used for data collection. The questionnaire was subjected to face-and content validity by experts in education and gave a reliability coefficient of 0.85 using Cronbach Alpha reliability test. Mean and standard deviation were used for answering the research questions while t-test analysis was used in testing the hypotheses for the study at 0.05 level of significance. The findings revealed no significant difference in the opinion of the respondents on the impact of banditry activities on STEM education for skills acquisition in Zamfara State. The study recommended among others that the provision of multifunctional mobile laboratory intervention, organization of workshops and conferences on the significance of STEM education should be encouraged at all levels.

Keywords: Multifunctional-Mobile-intervention, Banditry activities, Skills acquisition.

INTRODUCTION

In Nigeria, the use of practical supports for theoretical teachings of science had always been through the conventional laboratories which contain auxiliaries like retort stands, clamps, beakers, burettes, ray boxes, pulley system and other experimental functionaries usually in small confinement that is not only conducive and convenient enough for effective participatory teaching and learning, but is also very expensive and expansive in space utilization (Lawal, 2008). There have been several challenges facing the educational system of Nigeria; one of these challenges is the lack of proper equipment and teaching aids for the teachers to properly demonstrate the theoretically acquired knowledge for more understanding (Isma'il & Lukman, 2022; Lawal, 2008).

Science educational mobile intervention laboratory that is multifunctional mobile teaching aid that also serves as intervention laboratory for basic, science and secondary schools (Lawal, 2016). It could equally be deployed virtually and through other information and technology means and social media platform especially in the case of any lockdown and shut down of schools. The overwhelming feedbacks from the teachers, schools and educational stakeholders especially Kaduna state Government that has adopted the invention in her schools has been a strong endorsement of its utility and versatility culminating in further improvement, upgrade and automation from researchers and innovators on one hand and market interests from educational managers on the other hand as reported in leadership newspaper, 2019, Engineering Forum News, 2019 and sun news online, 2021.The level of technology of the

country has seriously affected many sectors of the country, the educational system inclusive. In our schools at all level of education today, the practical knowledge of students has been very poor because of lack of practical exposure which has affected their rate of assimilation (Momoh, 2021).The unavailability of these equipment could be traced down to some reasons namely cost of shipping the equipment from outside the country, lack of raw materials for the production of the equipment, challenges of unavailable spare parts to replace the damaged ones, the invention of the science educational mobile intervention laboratory table is a way out of the aforementioned challenges.

The manual means of lifting and adjusting the height of the invented science mobile intervention laboratory is becoming tiring and boring due to unequal applied forces by the two individuals. also, the uneven distribution of forces through the shaft connected to the lifting mechanism in the automated version of the science educational mobile intervention laboratory leads to same challenges as the manual one. In the quest to deploy technology to ameliorate this needed improvement on the originally invented mechanical equipment, the need for the automation of the lifting mechanism of the equipment for appropriate height adjustment was carried out and reported by Alkali, 2019, Inyang, 2019, Paul, 2019, Awoyemi, 2019 and Momoh, 2021 with the original patent owner and inventor (Lawal, 2016).

Banditry is one of the major problems threatening the nations' socio-economic development, particularly Zamfara State. The high incidence of banditry has assumed dangerous dimensions thereby disrupting the social life of the people and hampering the educational progress of the citizens in Zamfara State. Consequently, hardly a day passes without news of banditry, reported in some of the national dailies (Dantala, 2014). Presently, Zamfara state residents are forced to sleep with one eye open in an environment of uncertain tings while the governments charged with the responsibility of protecting the citizens seems confused and handicapped (Nwozor, 2013).

However, the current security challenges on menace of banditry activities in Zamfara Sate appear to be a thorn in the flesh in the educational development of the people of Zamfara State. Zamfara, one of the States created in 1996 out of the then Sokoto State shares common boundaries with Katsina to the East, Sokoto State to the West, Kebbi, Niaja and Kaduna State to the South (International Crisis Group, 2020). The state comprises 14 local government areas with a land mass of 39,762km² and with a population of 3.3million people based on national census figure of 2006. Most of Zamfara state is savanna occasionally interspersed with vast forests that provides homes to thousands of most Fulani herders. The incidence of migration and violent clashes between Fulani herders and farmers in many parts of the state has made it possible for a new dimension of security threats to be common occurrence. These are armed banditry, arms trafficking, cattle rustling, illegal mining of solid minerals, smuggling as well as kidnapping for ransom among others (International Crisis Group, 2020).

Zamfara State is one the states in the North-West that is constantly being affected or terrorized by security challenges arising from the above vices. This has not only affected economic activities of the people but has become worrisome in relation to the educational progress in the state with regards to education for skill acquisition among secondary school students in Zamfara State. Based on the importance of leveraging STEM Education, it becomes imperative to forestall or explore on menace of banditry activities. STEM education equips learners with practical skills and innovative thinking needed to solve real-world problems and thrive in a technology driven economy (Isma'il *et al.,* 2023). This is why it becomes expedient to address the issue of leveraging STEM Education using multi-functional-mobile intervention in a midst of banditry activities for sustainable skill acquisition among secondary school students in Zamfara State. Olayoku (2014) and Lawal *et al.,* (2018) asserts that the genesis of security challenges in Zamfara State could be attributed to the periods 2009 to 2011 but aggravated after the general election 2019. Anka (2017) observed that the incidence between the Fulani herders and the people in some parts of Zamfara State such as Dumburum in Zurmi, Badarawa in Shinkafi, Kizara in Tsafe and Dangulbi in Maru Local Government resulted to reprisal attacks that led to the death of many people in the area. According to WANEP NEW (2019) over 5,000 women were widowed, 25,000 were orphaned while more than 190,000 others were displaced.

Furthermore, the immediate cause of increase in security challenges was the activities of the "Yansakai" group which was born out of the banditry activities of the local people who were mostly Fulani herders. During this time, the nomads harassed people in isolated communities in many parts of Zamfara state. According to Olayokun(2014) in an attempt to checkmate the activities of the Fulanis who were harassing the local communities using cutlasses, dane guns and sticks for their operations especially in isolated villages and forest, the Yansakai or the vigilante group carried out their own operation against this Fulanis at the rural communities. In that operation in Maru LGA in Zamfara state, the vigilante group killed an ex-police officer named Samaila Yakubu and another Fulani who was set ablaze inside his pickup van. The Fulanis went and regrouped and organized themselves into different groups, acquiring dangerous weapons such as Ak47, double- and single-barrel guns, dane guns and general-purpose machine guns and planned reprisal attack on the people. This attack resulted to so many casualties including

damage to farms educational institutions and other social activities in Zamfara state.

The above not only disrupted socio-economic activities of the people but also truncated the educational progress especially through sustainable skills acquisition among secondary school students in Zamfara State. It could be noted that there is no village in Zamfara State that has not witnessed the impact of armed banditry. Rufai (2018) observes that in Mada district in Gusau Local Government Area, over 12 different attacks by bandits claim the life of over 20 people and 1,500 cattle stolen at different times from 2014-2016. This has naturally science education programs for skills acquisition in Zamfara State. Consequently, these security challenges are common occurrence in almost all the villages in the state. Against this backdrop, this study seeks to investigate leveraging STEM Education using multi-functional-mobile laboratory intervention in a midst of banditry for sustainable skill acquisition among secondary school students in Zamfara State.

Development and Utilization of Multi-Functional Mobile Laboratory Intervention

Some major factors like cost, availability of raw materials and weight among others were put into consideration during the design of the project.

Selection of Engineering Materials

Selection of the right materials during construction is a vital decision to make as it is a major factor that determines the success of project as the design engineer's understanding of engineering materials and their properties is critical. The impact of production methods and heat treatment on the properties of materials must be understood by a construction engineer. The following are the key categories of engineering materials namely metals and their alloys, such as Iron, steel, copper, aluminum and Non-metals, such as glass, polymers, elastomers, ceramics etc. The parts and materials used in this work are presented in Table 1 below: -

Table 1: Parts and Materials

Part no	Description	Quantity Required	Materials
1	Square pipe	418 feet, 1x1	Mild steel
2	Square pipe	18 feet, $^3/_4$x$^3/_4$	Mild Steel
3	Rectangular pipe	118 feet, 2x1	Mild Steel
4	Laminated plywood	1 4ft by 8ft	MDF Wood
5	Hinges	2	Mild steel
6	Angle brackets	28	Mild steel
7	Rollers	4	Steel and plastic
8	Contact adhesive	1	Wood adhesive
9	Bolts and nuts	28M4,	Mild steel
10	Screws	8 $\frac{3"}{4}$,	mild steel
11	Spur gears	2	Mild steel
12	Microcontrollers		
13	Edges tape		Plastic

Design and Construction Processes

The development and automation of science education mobile intervention laboratory carried out includes the following: -

Fabrication of Metal Frame

1. The pipes were marked out to the various lengths of the improved science educational mobile intervention laboratory metal frame using scriber, tape rule, and tri-square.
2. The marked-out lengths on the pipes were clamped on bench vice one after the other and were cut into the marked-out dimensions using a hacksaw. Straightness of the hand during cutting was strictly ensured in order to obtain a straight cut-edge of the pipes.
3. The cut pipes were joined together in an orderly manner to obtain the exact shape of the designed metal frame of the work using the electric arc-welding machine at 120A, and E6013 electrode.
4. The angle brackets were welded to the metal frame on the right positions of the frame where the plywood will bolt to.
5. Four rollers, two with a stopper and two without stopper, were welded to the four legs of the frame.
6. All the welded joints on the metal frame were grinded to a fine surface using the hand-held grinding machine.
7. Potty filler was applied to the grinded welded joints after been mixed with a hardener, and was scrubbed with a San-paper to give it a fine-finished look.
8. The plywood were then marked out to the various dimensions using a tape rule and a pencil.
9. The marked-out dimensions on the plywood were cut out using the circular wood saw.

10. The 105cm by 100cm size board's edges was covered with edges tape, held firmly to the edges of the board using the wood adhesive.
11. The welded metal frame was sprayed with a white paint using a compressor spraying machine and left for a day to dry.
12. The cut plywood were attached to the metal frame using bolts, nuts, and a screwing machine.
13. 10mm holes were drilled on the 110cm by 100cm board with 1cm equidistance apart using a drill bit, and a hand-held drilling machine.
14. The perforated board was attached to the two arms of $\frac{3''}{4}$pipes which protruded from the two sides of the table top using a U-shaped clamp.

The invented multifunctional mobile teaching aid are shown in Figures 1 below:

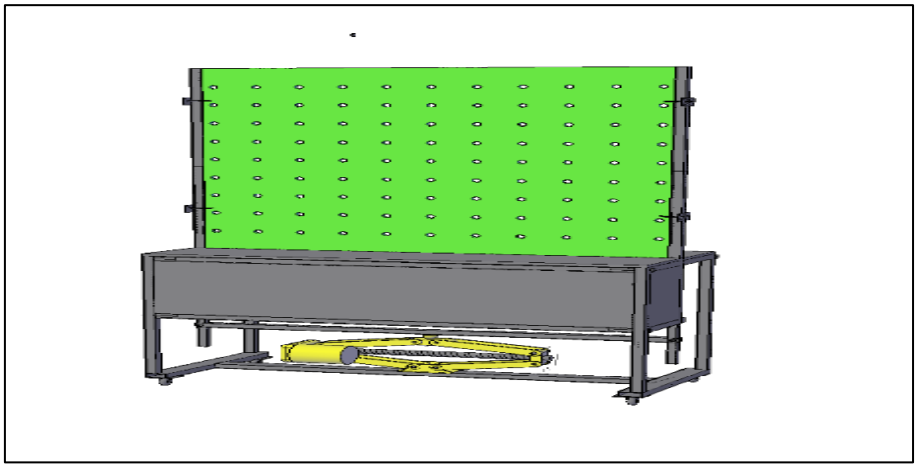


Figure 1: The Invented and automated Multifunctional Teaching aid

Experimentations

One of the experiments carried out was to determine the Height of the Equipment using the Simple Pendulum principle.

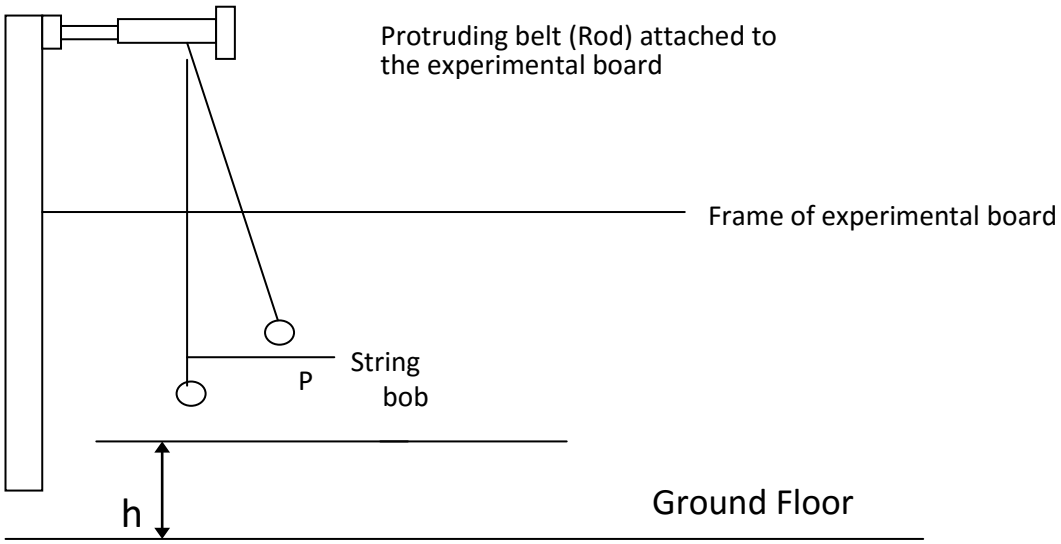


Figure 2: Diagram of simple pendulum experiment to determine height of the equipment

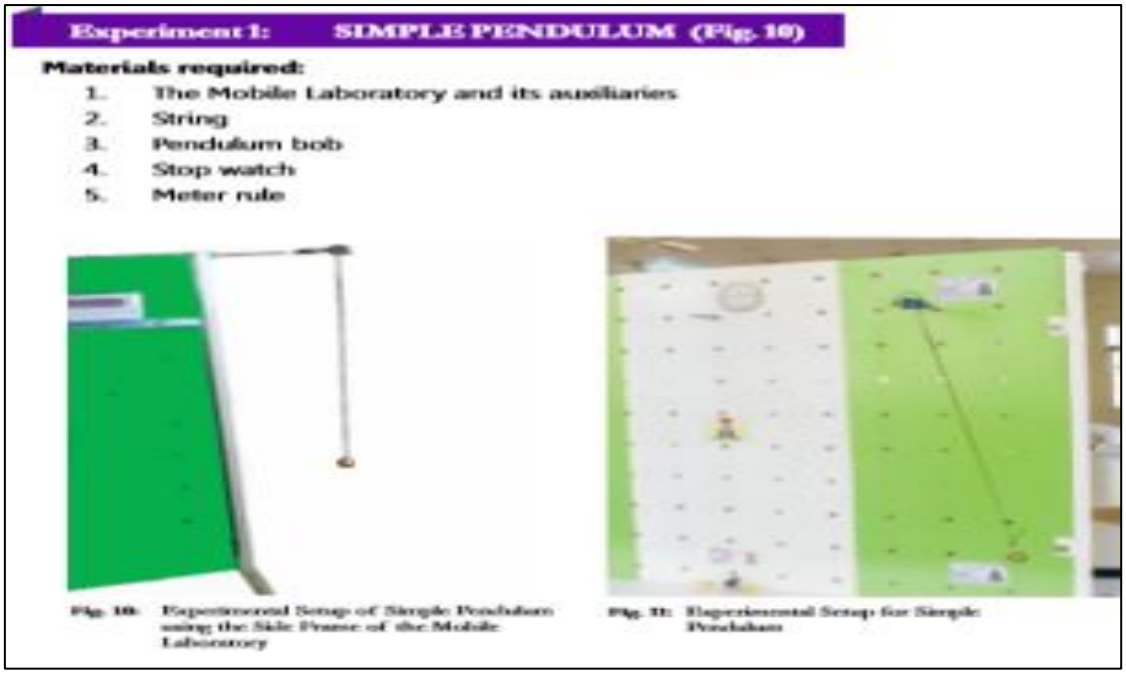


Figure 3: Screenshot of the Simple Pendulum experimentation set up on the equipment

Apparatus: Pendulum, Stop watch, Meter rule, String, Protruding bolt (rod), Multifunctional Mobile teaching aid and Intervention laboratory.

PROCEDURE

The protruding bolt (rod) is attached inserted on the welded nut at the highest side of the experimental board the simple pendulum is then hung on the protruding rod and the height of the bob above the floor is adjusted for the various height starting with 20km above the floor, the bob was set swinging through a small angle and the time for 20 oscillations was counted the experiment was repeated by adjusting the height above the floor for 30cm, 40cm, 50cm, 60cm.

The Table 2 below are the experimental readings from the multifunctional teaching aid and intervention laboratory.

Table 2: Values from the experimental readings

Height above floor (cm)	1 2 average	Time for 20	oscillation(s)	T(S)	Period T(s)
20	48	49	48.5	2.42	5.88
30	46	46	46	2.3	5.29
40	44	44	44	2.2	4.84
50	42	42	42	2.1	4.41
60	40	40	40	2	4.00

Theory and Calculations

From the simple pendulum equation for periodic time (T)

T= 2

But L = H-h (7)

Where, H = height of the experimental board, h = height of the bob above the floor

$= 2\pi = \frac{\sqrt{H-h}}{g}$

Therefore, T (Abbot,1989, Nelkon and Parker,1995) (8)

Expanding $T^2 = 4\pi^2 \frac{H-h}{g}$ (9), $\frac{gT^2}{4\pi^2} = H$ - h,

When $T^2 = 0$,

H – h = 0, Which implies h = H at $T^2 = 0$

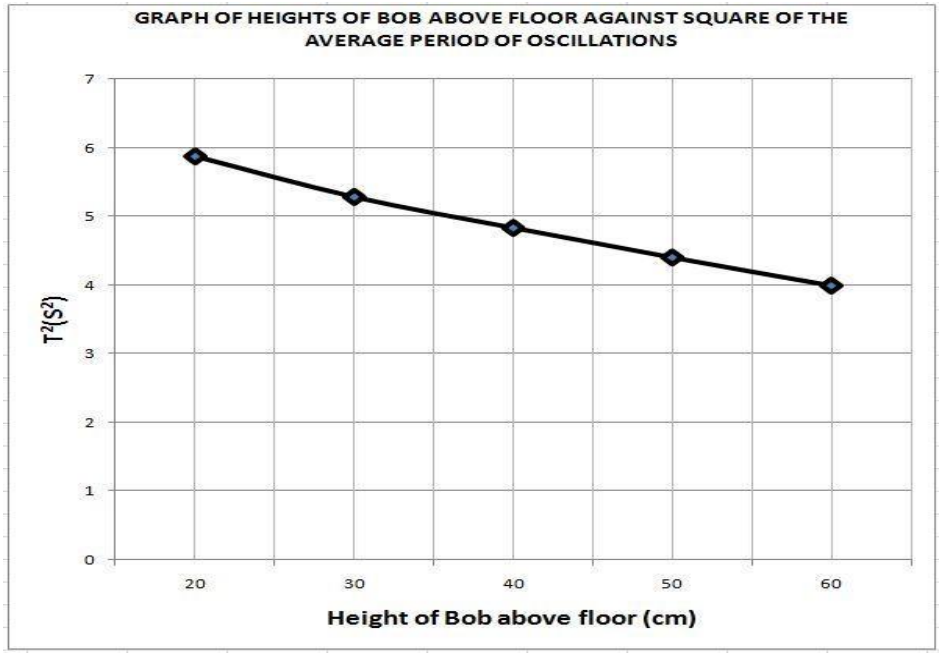


Figure 4: Graph of period of oscillation against height of bob above floor

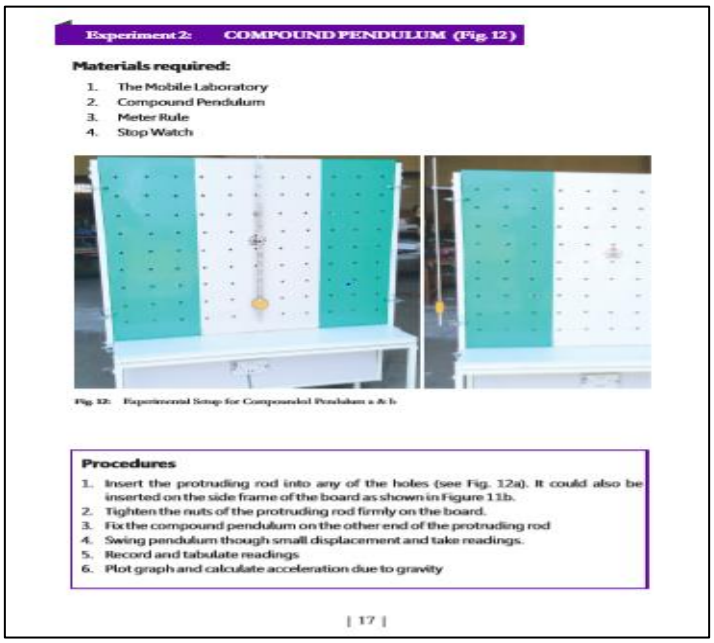
Actual height of the experimental board is 170cm
From the graph in figure 5
When T^2 = 0, h = 165cm, This H – h = 0, H = 165cm,
Error estimated= (165-170) cm = -5cm

% error= $\frac{Difference\ in\ height}{Actual\ Heiight}\ x\ 100$ (10)

$\frac{-5}{170}$ x 100 = 2.9 %

This result shows another encouraging output of the multifunctional teaching aid and intervention with minimum experimental results and error of 165cm + 2.9%.

Screenshot from the Monograph of the equipment of some experimental set up and procedures for Physics, Chemistry and Biology are shown below:



Experiment 2: COMPOUND PENDULUM (Fig. 12)

Materials required:

1. The Mobile Laboratory
2. Compound Pendulum
3. Meter Rule
4. Stop Watch

Procedures

1. Insert the protruding rod into any of the holes (see Fig. 12a). It could also be inserted on the side frame of the board as shown in Figure 11b.
2. Tighten the nuts of the protruding rod firmly on the board.
3. Fix the compound pendulum on the other end of the protruding rod
4. Swing pendulum though small displacement and take readings.
5. Record and tabulate readings
6. Plot graph and calculate acceleration due to gravity

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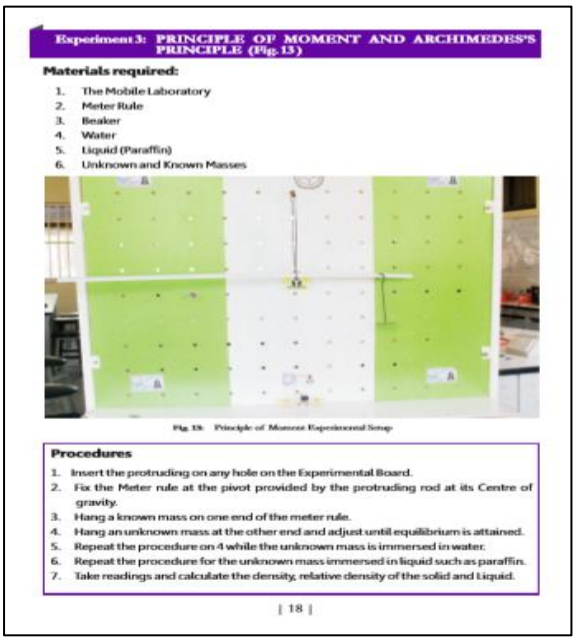

Experiment 3: PRINCIPLE OF MOMENT AND ARCHIMEDES'S PRINCIPLE (Fig. 13)

Materials required:

1. The Mobile Laboratory
2. Meter Rule
3. Beaker
4. Water
5. Liquid (Paraffin)
6. Unknown and Known Masses

Procedures

1. Insert the protruding on any hole on the Experimental Board.
2. Fix the Meter rule at the pivot provided by the protruding rod at its Centre of gravity.
3. Hang a known mass on one end of the meter rule.
4. Hang an unknown mass at the other end and adjust until equilibrium is attained.
5. Repeat the procedure on 4 while the unknown mass is immersed in water.
6. Repeat the procedure for the unknown mass immersed in liquid such as paraffin.
7. Take readings and calculate the density, relative density of the solid and Liquid.

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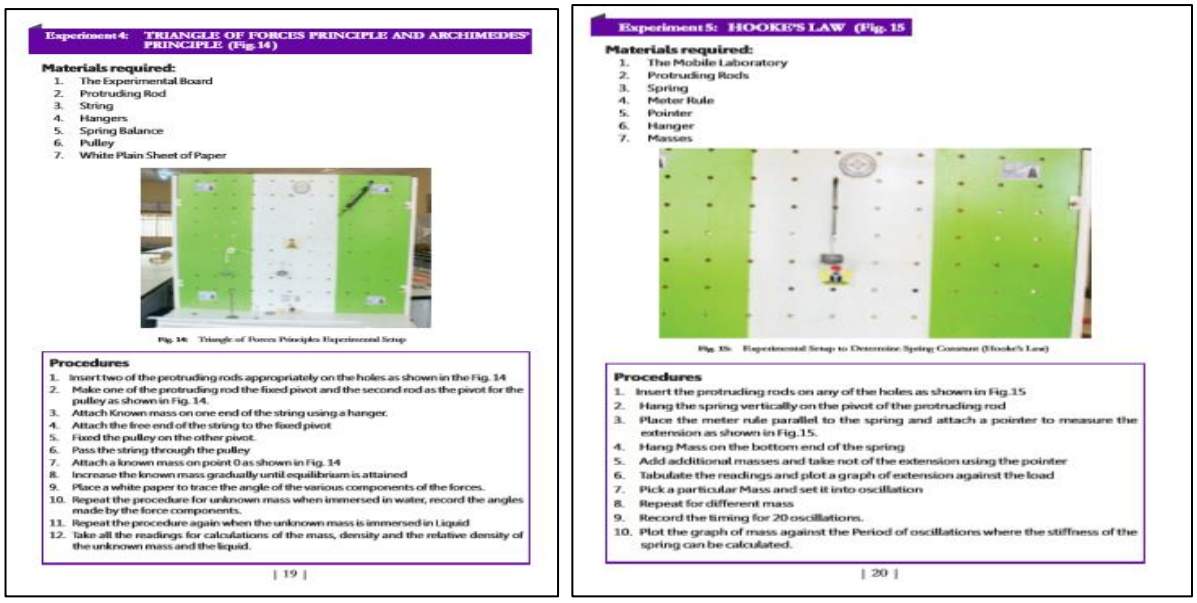

Experiment 4: TRIANGLE OF FORCES PRINCIPLE AND ARCHIMEDES' PRINCIPLE (Fig. 14)

Materials required:

1. The Experimental Board
2. Protruding Rod
3. String
4. Hangers
5. Spring Balance
6. Pulley
7. White Plain Sheet of Paper

Fig. 14: Triangle of Forces Principles Experimental Setup

Procedures

1. Insert two of the protruding rods appropriately on the holes as shown in the Fig. 14
2. Make one of the protruding rod the fixed pivot and the second rod as the pivot for the pulley as shown in Fig. 14.
3. Attach Known mass on one end of the string using a hanger.
4. Attach the free end of the string to the fixed pivot
5. Fixed the pulley on the other pivot.
6. Pass the string through the pulley
7. Attach a known mass on point 0 as shown in Fig. 14
8. Increase the known mass gradually until equilibrium is attained
9. Place a white paper to trace the angle of the various components of the forces.
10. Repeat the procedure for unknown mass when immersed in water, record the angles made by the force components.
11. Repeat the procedure again when the unknown mass is immersed in Liquid
12. Take all the readings for calculations of the mass, density and the relative density of the unknown mass and the liquid.

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Experiment 5: HOOKE'S LAW (Fig. 15

Materials required:

1. The Mobile Laboratory
2. Protruding Rods
3. Spring
4. Meter Rule
5. Pointer
6. Hanger
7. Masses

Fig. 15: Experimental Setup to Determine Spring Constant (Hooke's Law)

Procedures

1. Insert the protruding rods on any of the holes as shown in Fig.15
2. Hang the spring vertically on the pivot of the protruding rod
3. Place the meter rule parallel to the spring and attach a pointer to measure the extension as shown in Fig.15.
4. Hang Mass on the bottom end of the spring
5. Add additional masses and take not of the extension using the pointer
6. Tabulate the readings and plot a graph of extension against the load
7. Pick a particular Mass and set it into oscillation
8. Repeat for different mass
9. Record the timing for 20 oscillations.
10. Plot the graph of mass against the Period of oscillations where the stiffness of the spring can be calculated.

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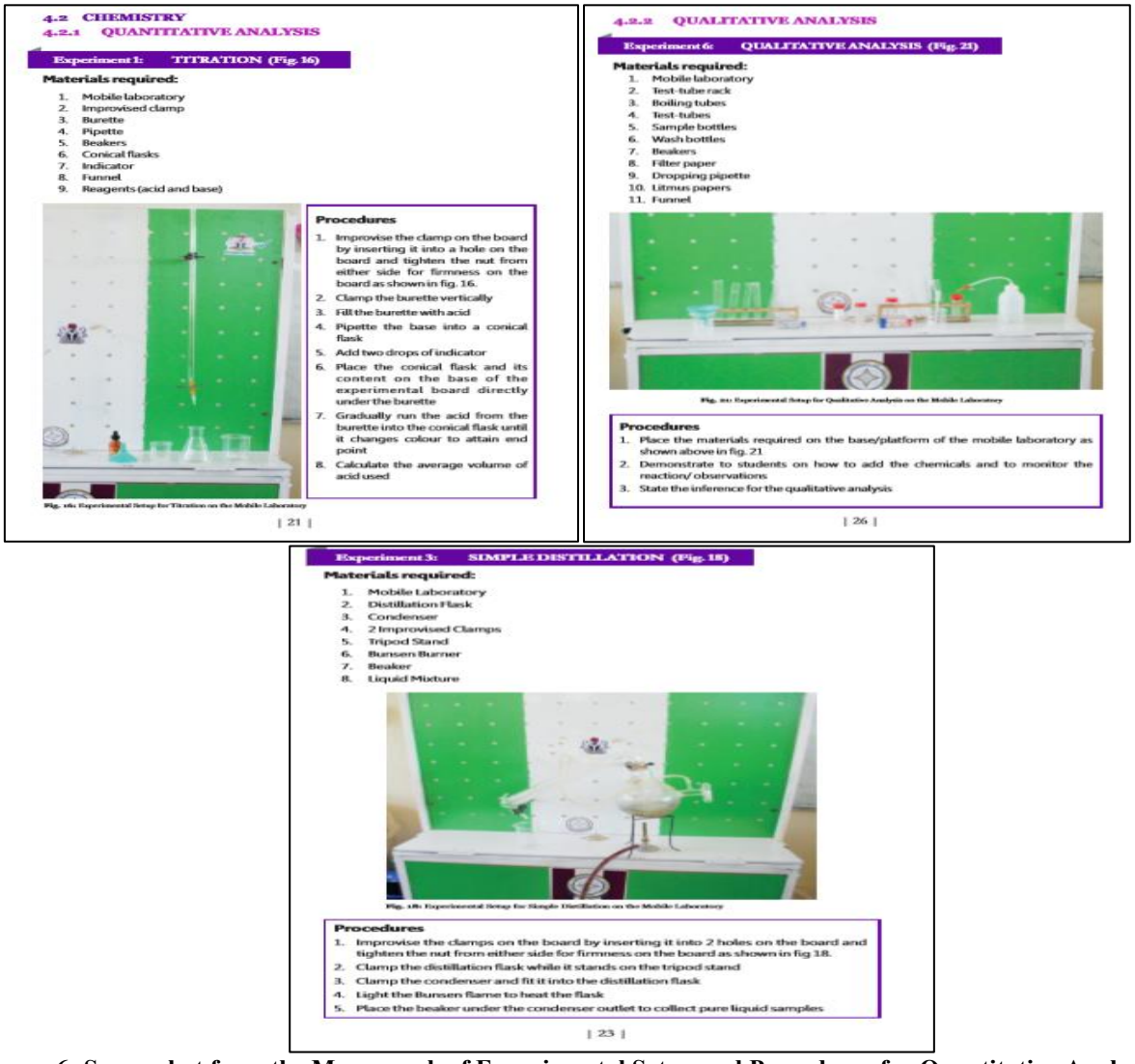
Figure 5: Screenshot for the Monograph for the Experimental setup and procedures for Compound Pendulum, Moment Principle, Triangle of Forces and Hooke's Law in Physics



4.2 CHEMISTRY

4.2.1 QUANTITATIVE ANALYSIS

Experiment 1: TITRATION (Fig. 16)

Materials required:

1. Mobile laboratory
2. Improvised clamp
3. Burette
4. Pipette
5. Beakers
6. Conical flasks
7. Indicator
8. Funnel
9. Reagents (acid and base)

Procedures

1. Improvise the clamp on the board by inserting it into a hole on the board and tighten the nut from either side for firmness on the board as shown in fig. 16.
2. Clamp the burette vertically
3. Fill the burette with acid
4. Pipette the base into a conical flask
5. Add two drops of indicator
6. Place the conical flask and its content on the base of the experimental board directly under the burette
7. Gradually run the acid from the burette into the conical flask until it changes colour to attain end point
8. Calculate the average volume of acid used

Fig. 16: Experimental Setup for Titration on the Mobile Laboratory

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4.2.2 QUALITATIVE ANALYSIS

Experiment 6: QUALITATIVE ANALYSIS (Fig. 21)

Materials required:

1. Mobile laboratory
2. Test-tube rack
3. Boiling tubes
4. Test-tubes
5. Sample bottles
6. Wash bottles
7. Beakers
8. Filter paper
9. Dropping pipette
10. Litmus papers
11. Funnel

Fig. 21: Experimental Setup for Qualitative Analysis on the Mobile Laboratory

Procedures

1. Place the materials required on the base/platform of the mobile laboratory as shown above in fig. 21
2. Demonstrate to students on how to add the chemicals and to monitor the reaction/ observations
3. State the inference for the qualitative analysis

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Experiment 3: SIMPLE DISTILLATION (Fig. 18)

Materials required:

1. Mobile Laboratory
2. Distillation Flask
3. Condenser
4. 2 Improvised Clamps
5. Tripod Stand
6. Bunsen Burner
7. Beaker
8. Liquid Mixture

Fig. 18: Experimental Setup for Simple Distillation on the Mobile Laboratory

Procedures

1. Improvise the clamps on the board by inserting it into 2 holes on the board and tighten the nut from either side for firmness on the board as shown in fig 18.
2. Clamp the distillation flask while it stands on the tripod stand
3. Clamp the condenser and fit it into the distillation flask
4. Light the Bunsen flame to heat the flask
5. Place the beaker under the condenser outlet to collect pure liquid samples

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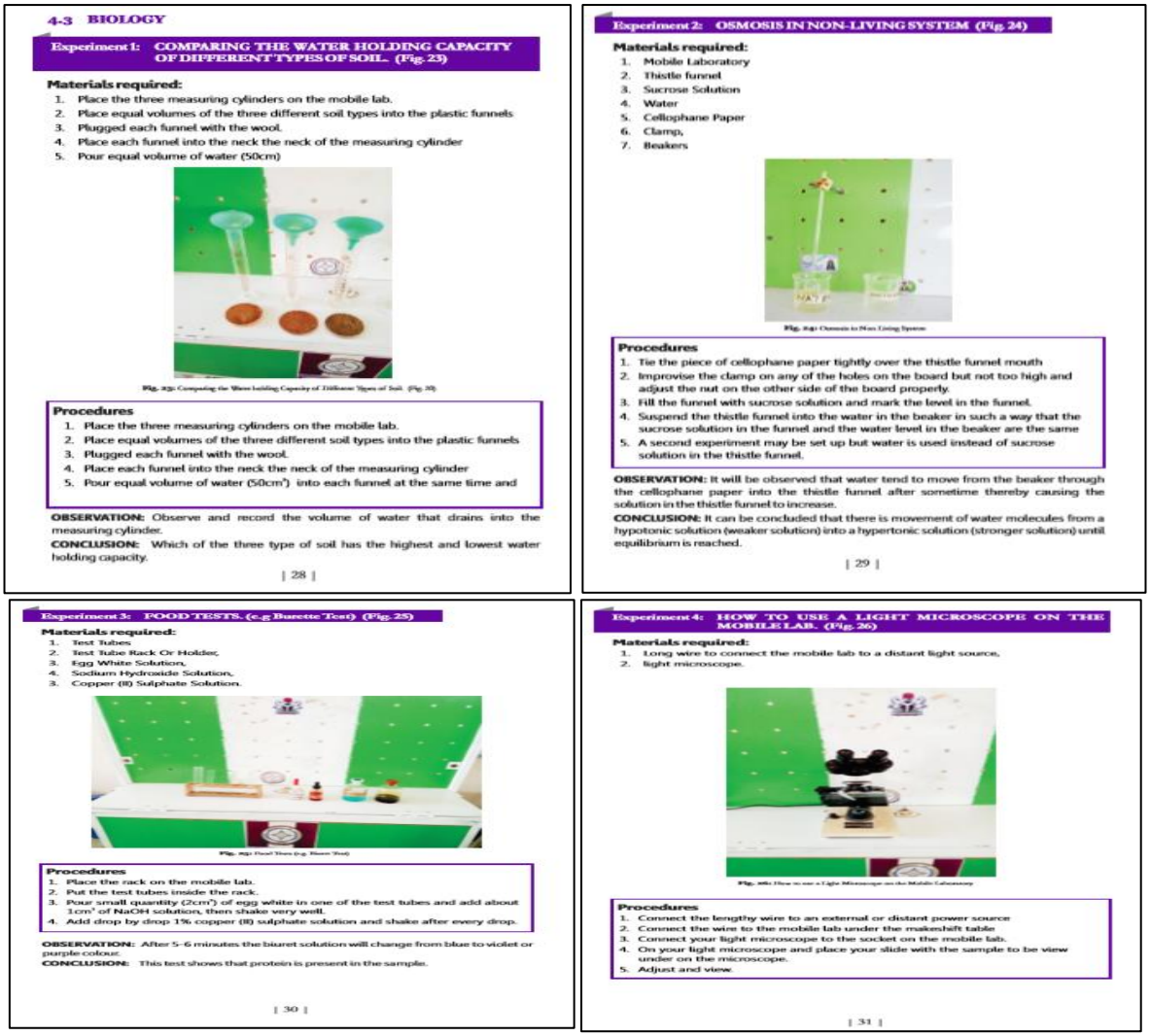
Figure 6: Screenshot from the Monograph of Experimental Setup and Procedures for Quantitative Analysis (Titration), Qualitative Analysis and Simple Distillation in Chemistry



4-3 BIOLOGY

Experiment 1: COMPARING THE WATER HOLDING CAPACITY OF DIFFERENT TYPES OF SOIL. (Fig. 23)

Materials required:
1. Place the three measuring cylinders on the mobile lab.
2. Place equal volumes of the three different soil types into the plastic funnels
3. Plugged each funnel with the wool.
4. Place each funnel into the neck the neck of the measuring cylinder
5. Pour equal volume of water (50cm)

Procedures
1. Place the three measuring cylinders on the mobile lab.
2. Place equal volumes of the three different soil types into the plastic funnels
3. Plugged each funnel with the wool.
4. Place each funnel into the neck the neck of the measuring cylinder
5. Pour equal volume of water (50cm³) into each funnel at the same time and

OBSERVATION: Observe and record the volume of water that drains into the measuring cylinder.
CONCLUSION: Which of the three type of soil has the highest and lowest water holding capacity.

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Experiment 2: OSMOSIS IN NON-LIVING SYSTEM (Fig. 24)

Materials required:
1. Mobile Laboratory
2. Thistle funnel
3. Sucrose Solution
4. Water
5. Cellophane Paper
6. Clamp,
7. Beakers

Procedures
1. Tie the piece of cellophane paper tightly over the thistle funnel mouth
2. Improvise the clamp on any of the holes on the board but not too high and adjust the nut on the other side of the board properly.
3. Fill the funnel with sucrose solution and mark the level in the funnel.
4. Suspend the thistle funnel into the water in the beaker in such a way that the sucrose solution in the funnel and the water level in the beaker are the same
5. A second experiment may be set up but water is used instead of sucrose solution in the thistle funnel.

OBSERVATION: It will be observed that water tend to move from the beaker through the cellophane paper into the thistle funnel after sometime thereby causing the solution in the thistle funnel to increase.
CONCLUSION: It can be concluded that there is movement of water molecules from a hypotonic solution (weaker solution) into a hypertonic solution (stronger solution) until equilibrium is reached.

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Experiment 3: FOOD TESTS. (e.g Burette Test) (Fig. 25)

Materials required:
1. Test Tubes
2. Test Tube Rack Or Holder,
3. Egg White Solution,
4. Sodium Hydroxide Solution,
5. Copper (II) Sulphate Solution.

Procedures
1. Place the rack on the mobile lab.
2. Put the test tubes inside the rack.
3. Pour small quantity (2cm³) of egg white in one of the test tubes and add about 1cm³ of NaOH solution, then shake very well.
4. Add drop by drop 1% copper (II) sulphate solution and shake after every drop.

OBSERVATION: After 5-6 minutes the biuret solution will change from blue to violet or purple colour.
CONCLUSION: This test shows that protein is present in the sample.

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Experiment 4: HOW TO USE A LIGHT MICROSCOPE ON THE MOBILE LAB. (Fig. 26)

Materials required:
1. Long wire to connect the mobile lab to a distant light source,
2. light microscope.

Procedures
1. Connect the lengthy wire to an external or distant power source
2. Connect the wire to the mobile lab under the makeshift table
3. Connect your light microscope to the socket on the mobile lab.
4. On your light microscope and place your slide with the sample to be view under on the microscope.
5. Adjust and view.

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Figure 7: Screenshot from the Monograph of Experimental Setup and Procedures for Water holding Capacity of Soils, Osmosis in Bon-living System, Food Tests and Light Microscope in Biology

4.4 MATHEMATICS

4.4.1 Mathematical Shapes and Coordinates on the Mobile Laboratory

The teacher could adapt it for explaining Pythagoras theorem, Lami's theorem, shapes, plotting of graphs and so on.
The use of masking tapes or white stickers could be used in tracing shapes and explaining graphs for students.

4.4.2 Mathematical Graphs Plotting on the Mobile Laboratory

Materials Needed
1. Cello Tape / Paper Tape/ Masking Tape
2. Twine / Rope (tiny Rope)
3. Thread
4. White Stickers
5. Marker (White Board)

Procedures
i. Get your mobile lab ready
ii. Use the Cello tape / Paper tape/ Masking tape to divide your graph into x-axis and y-axis
iii. Choose a suitable scale for x-axis and y-axis (depending on the values of x and y)
iv. Plot all your points and draw a line or curve (depending on the type of graph you want to plot) which can be linear graph, quadratic graph, tangent and gradient of a curve.

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Figure 8: Screenshot from the Monograph of Experimental Setup and Procedures for Mathematical Shapes, Coordinates and Graph Plotting in Mathematics

The multifunctional Mobile Teaching Aid and Intervention Laboratory invented and furthered automated was tested to perform some experiments in Physics, Biology, Chemistry, Mathematics and some basic technologies has shown its utility and versatility with promising status as a positive disruptive game

changer in teaching, demonstrations and conduct of practical in science classes effectively for the improvement of the basic, science, secondary and technical educational standard for sustainable skills acquisition among secondary school students in Zamfara State. The Simple pendulum experimental determination of the height of the equipment as 165cm against the actual height of 170cm with 2.9% minimum error is testament on the effectiveness of the multifunctional teaching aid and intervention laboratory.

Aim and Objectives of the study

The main purpose of this study is to investigate leveraging STEM Education using multi-functional-mobile laboratory intervention in a midst of banditry activities for sustainable skill acquisition among secondary school students in Zamfara State

1. Identify the Nature of banditry activities on utilization of multi-functional mobile laboratory for skill acquisition among secondary school students in Zamfara State
2. Determine the consequences of banditry activities on utilization of multi-functional mobile laboratory for skill acquisition among secondary school students in Zamfara State

Research Questions

The following research questions were formulated to guide the study

- What is the Nature of banditry activities on utilization of multi-functional mobile laboratory for skill acquisition among secondary school students in Zamfara State?
- What are the consequences of banditry activities on utilization of multi-functional mobile laboratory for skill acquisition among secondary school students in Zamfara State?

Hypotheses

The following null hypotheses will guide the study and will be tested at 0.05 level of significance

H_{o1}: There is no significant difference between mean response of male and female respondents on the Nature of banditry activities on utilization of multi-functional mobile laboratory for skill acquisition among secondary school students in Zamfara State.

H_{o2}: There is no significant difference between mean response of male and female respondents on the impact of banditry activities on utilization of multi-functional mobile laboratory for skill acquisition among secondary school students in Zamfara State.

METHODOLOGY

The study adopted a mixed method research design using both qualitative and quantitative data. Two research questions and two null hypotheses tested at 0.05 level of significance guided the study. The population comprised of 30 Principals and 30 Science Teachers in Zamfara Local Government Education Authority purposively sampled and used as the sample size of the study in line with Sodangi *et al.,* (2023). A researcher-designed questionnaire which was validated by three experts with reliability coefficient of 0.85 obtained using Cronbach Alpha method. The instrument was structured on a 4 point rating scale of Strongly Agree (SA), Agree (A), Disagree (D) and Strongly Disagree (SD) with assigned values of 4, 3, 2, and 1 respectively. Mean and standard deviation were used in answering the research questions while t- test analysis was used in testing the hypotheses at 0.05 levels of significance.

Presentation of Results

Research Question 1

What is the Nature of banditry activities on utilization of multi-functional mobile laboratory intervention for skill acquisition among secondary school students in Zamfara State?

Table 1: Mean ratings of Principals on the nature of banditry activities on utilization of multifunctional laboratory intervention

S/N	Item Statement	X	SD	Dec
1	Science Schools centers are closed down for security reasons	3.03	0.70	Agree
2	School structures are destroyed by bandits	3.16	0.62	Agree
3	Families are displaced from their homes	3.20	0.60	Agree
4	Some teachers are kidnapped by unknown persons	3.14	0.63	Agree
5	Many school records are destroyed	3.30	0.56	Agree
6	Some schools are set ablaze by Fulani herdsmen	3.22	0.61	Agree
7	Learning facilities are burnt by herdsmen	3.25	0.65	Agree
8	School calendars are affected	3.12	0.68	Agree
Grand mean		3.16	0.62	Agree

The result in table one shows the responses of the principals on the nature of banditry activities on utilization of multi-functional mobile laboratory intervention for skill acquisition among secondary school students in Zamfara State. The mean scores of the respondents on items 1-8 are seen to be above the criterion mean of 2.50 benchmark for acceptance level. This implies that the respondents are in agreement that items 1-8 are the nature of banditry activities on utilization of multi-functional mobile laboratory for skill acquisition among secondary school students in Zamfara State. The cluster mean and the standard deviation is an

indication that the respondents' views are close to each other on the items. This grand mean supports the above result.

Research Question 2

What is the impact of banditry activities on utilization of multi-functional mobile laboratory intervention for skill acquisition among secondary school students in Zamfara State

Table 2: Mean ratings of respondents on the impact of banditry activities on utilization of multi-functional mobile laboratory intervention for skill acquisition among secondary school students in Zamfara State

S/N	Item Statement	X	SD	Dec
9	Insecurity leads to closure of schools	3.01	0.70	Agree
10	It hampers education activities of the children	3.20	0.65	Agree
11	It leads to burning of schools	3.10	0.68	Agree
12	Insecurity affects educational development of the state	3.30	0.62	Agree
13	It widens the gap of underdevelopment in education in the area	3.06	0.69	Agree
14	It leads to change of academic calendar of schools	3.24	0.64	Agree
15	It leads to abandonment of school activities	3.00	0.71	Agree
16	It leads to displacement of teachers in schools	3.14	0.63	Agree
Grand mean		3.10	0.68	Agree

Result in table 2 above shows that the mean scores of the impact of banditry activities on utilization of multi-functional mobile laboratory intervention for skill acquisition among secondary school students in Zamfara State are observed to be above 2.50 criterion mean for acceptance of an item on items 9-16 on the table. This implies that the respondents are in agreement that items 9-16 are the consequences of banditry activities on utilization of multi-functional mobile laboratory intervention for skill acquisition among secondary school students in Zamfara State. The above result is also supported by the mean scores of the respondents on the table.

Hypothesis 1

H_{o1}: There is no significant difference between mean response of male and female respondents on the Nature of banditry activities on utilization of multi-functional mobile laboratory for skill acquisition among secondary school students in Zamfara State

Table 3: t-test analysis of male and female respondents on the nature of security challenges on childhood education and sustainable development in the area

S/N	Gender	N	X	SD	df	Cal-t value	Critical-t value	Level of sign	Dec
1	Male	22	3.14	0.70	28	0.75	1.96	0.05	NS
2	Female	8	3.00	0.74					

Table 3 above shows that the calculated t-value of 0.75 is less than the critical t-value of 1.96 at 28 degree of freedom and 0.05 level of significance. Since the t-calculated value is less than t-critical value, the null hypotheses of no significant difference of the study is accepted. This implies that, there is no significant difference between mean response of male and female respondents on the nature of banditry activities on utilization of multi-functional mobile laboratory for skill acquisition among secondary school students in Zamfara State.

Hypothesis: 2

H_{o2}: There is no significant difference between mean response of male and female respondents on the impact of banditry activities on utilization of multi-functional mobile laboratory for skill acquisition among secondary school students in Zamfara State

Table 4: t-test analysis of male and female respondents on the impact of banditry activities on utilization of multi-functional mobile laboratory

S/N	Group	N	X	SD	df	Cal-t value	Critical-t value	Level of sign	Dec
1	Male	22	3.11	0.73	28	0.055	1.96	0.05	NS
2	Female	8	3.16	0.71					

Table 4 indicates that the calculated t-value of 0.055 is less than the critical t-value of 1.96 at 28 degree of freedom and 0.05 level of significance. Since the t-calculated value is less than t-critical value, the second hypothesis of no significant difference of the study is accepted. there is no significant difference between mean response of male and female respondents on the impact of banditry activities on utilization of multi-functional mobile laboratory for skill acquisition among secondary school students in Zamfara State.

DISCUSSION OF THE FINDINGS

The findings of the study identified the following as the nature of impact of security challenges

on STEM education for sustainable development in Zamfara State, North-West, Nigeria. These include closing of schools for security reasons, destruction of School structures by bandits or herdsmen, displacement of families from their homes and kidnapping of some teachers by unknown persons. Other nature of the impact of banditry activities on STEM education in the area include destruction of school records, setting some schools ablaze thereby destroying learning facilities and also affecting school academic calendars. The above findings are in agreement with the opinions of Dandala (2014) and also Tona (2012) who noted that the nature of banditry activities in Zamfara state included closure of schools, destruction of school records, displacement of teachers and burning of some school structures through activities of herdsmen and bandits. The above nature of the impact of banditry activities on STEM education and sustainable development in Zamfara State, North-West, was supported by the hypothesis of no significant difference of the study which was accepted implying no difference in the opinions of male and female respondent's head teachers in Zamfara state.

Furthermore, the findings of the study also indicated that the consequences of the impact of banditry on STEM education for sustainable skills in Zamfara State, include; closure of schools, hampering of educational activities of the children, burning of schools and affecting educational development of the state. Other consequences of the impact of security challenges on childhood education and sustainable development in Zamfara State are widening the gap of underdevelopment in education in the area, changing of academic calendar of schools, abandonment of school activities and displacement of teachers in schools. The above findings are in agreement with the view of Ozoh and Dinwobi (2018), Isma'il and Abubakar (2023) and Rufai (2018) who opined that security challenges in many parts of the country have affected not only economic activities but also untold damages to educational development at all levels. Furthermore, Anka (2017) observed that insecurity in many parts of Zamfara state has brought about further under development of the people educationally. This finding was equally supported by the acceptance of the hypothesis of no significant difference in the opinions of the male and female respondents in Zamfara state.

Implications for skills acquisition among secondary school students in Zamfara State

Based on the findings of the study, the implications to the government and people of Zamfara State are that if efforts are not made to checkmate the activities of banditry and other nefarious groups not only STEM Education but education generally in the state will be greatly truncated. This will be a cog in the wheel of skills acquisition in the area of science and technological development and advancement for sustainable economic development in Zamfara state.

Furthermore, the integration of STEM education using multi-functional mobile laboratory intervention in teaching and learning has become an emerging technology which can be streamed into global trend for skills acquisition and sustainable scientific and technological development. Hence, no country would like to be left out this development because of the enormous benefits attached to it. Consequently, upon this, finding of this study shows that most science schools lack adequate laboratory and multifunctional mobile laboratory intervention required for the teaching and learning of practical skills for skills acquisition. The implication of this finding is that science teachers would not be able to effectively integrate these forms of innovation in the teaching and learning process in order to enhance quality STEM Education.

Integration of Multi-Functional Mobile Laboratory in teaching and learning of STEM education will help to improve the quality of science education which provides students with opportunity to acquire necessary skills for 21st century survival. However, it is disheartening to note that majority of science education teachers do not make use of the available Multi-Functional Mobile Laboratory in the classroom. This implies that teachers lack the skills to implement new innovations in STEM education. Therefore, even when government and other stakeholders provide Multi-Functional Mobile Laboratory for STEM education, the hope of quality science education may not be attained because science education teachers do not make use of innovative pedagogies regularly to implement curriculum.

The application of Multi-Functional Mobile Laboratory is paramount to providing quality STEM education. Unfortunately, certain factors such as poor electricity supply, traditional classroom setting, lack of training and inadequacy of these technologies among others pauses barriers which prevent it from becoming a reality. By implication, quality STEM education in Zamfara State, Nigeria can only be achieved when such barriers identified by teachers are adequately addressed.

CONCLUSION

It is concluded from the findings of the study that the nature of the impact of security challenges on childhood education and sustainable development in Zamfara State, and the consequences requires serious governmental intervention since they remain serious security challenges to childhood education in the area and also sustainable educational development in the state.

RECOMMENDATIONS

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

1. The people of Zamfara and especially the school headteachers should report any acts of

security challenges within the state to the appropriate educational authorities and the government for immediate attention.

2. The government and people of Zamfara are to join hands or partner with each other in finding lasting solutions to the security challenges in many parts of the state which are undermining childhood education and sustainable educational development of the state.

Government at all levels. Educational Mangers and stakeholders and non-governmental, local and international educational support organizations are urged to take advantage of this home-grown and purpose-built invention to enhance quality educational delivery, scientific and technological ripples so as to address effectively the often-pervading dearth of equipment that is the usual narrative in our educational system

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