MONOGRAPH

SCIENCE EDUCATIONAL MOBILE INTERVENTION LABORATORY

RP:NG/P/2014/398

A MULTIFUNCTIONAL MOBILE TEACHING, DEMONSTRATION, DISPLAY AID AND LAB KIT FOR BASIC AND SECONDARY SCHOOLS

DE/PPM&R/34/CM&MLA (146 MINEDUCATE) NERDC/R.134/VOL.V/432

FEDERAL UNIVERSITY OF TECHNOLOGY, MINNA

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By

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FEDERAL MINISTRY OF EDUCATION

Federal Secretariat, Shehu Shagari Way, Abuja, Nigeria
EDUCATIONAL PLANING, RESEARCH AND DEVELOPMENT DEPARTMENT
OFFICE OF THE DIRECTOR

146 DE/PPM&R/34/CM&MLA

MINEDUCATE 6th April, 2017

Lawal Sadiq Sius,
Mechanical Engineering,
Federal University of Technology,
P.M.B. 65, Minna,
Niger State.

Re: Book Assessment

Title: Educational Mobile Laboratory

Author: Lawal Sadiq Sius

I am directed to forward the report of the assessment of the book Titled: ***"Educational Mobile Laboratory"*** to you.

2. The Laboratory Equipment has been assessed and found to be useful. It is therefore recommended as demonstration table for Basic Science and Technology; Basic Science and Basic Technology.

3. Please, accept the assurances of the Honourable Minister's regards.

Mrs. M. O. Anene-Maidoh
Director (Educational Planning, Research & Development)
For: Honourable Minister

NIGERIAN EDUCATIONAL RESEARCH AND DEVELOPMENT COUNCIL (NERDC)

Office of the Executive Secretary

Prof. Ismail Junaidu

Executive Secretary

OFFICE:
Lokoja-Kaduna Road, Sheda,
P.M.B 91, Abuja, Nigeria
www.nerdc.org.ng

NERDC/R.134/VOL.V/432 **12/01/2017**

Lawal Sadiq Sius

RE: BOOK ASSESSMENT

Title: Educational Mobile Laboratory

Author: Lawal Sadiq Sius

The Laboratory Equipment has been assessed by the NERDC and it was found to be useful. We therefore recommend it as a Science/Mathematics Demonstration Table.

A copy of the book and a synthesis of the assessors' report are hereby enclosed.

Prof. Ismail Junaidu
Executive Secretary

NIGERIAN EDUCATIONAL RESEARCH AND DEVELOPMENT COUNCIL (NERDC), SHEDA – ABUJA

ASSESSMENT AND RECOMMENDATION OF BOOKS/GENERAL READING MATERIALS

REPORT FORM

TITLE OF EDUCATIONAL MATERIAL AND AUTHOR
Educational Mobile Laboratory by Lawal Sadiq Sius

1. **APPROPRIATENESS OF TITLE (If not appropriate, suggest title)**
Not appropriate. Use the name Science/Mathematics Mobile Demonstration Table.

2. **DESIGN AND PRODUCTION**

(a) **General Appearance/Packaging:**
Local content is appreciable, packaging is good.

(b) **Design Quality :**
A fair initiative that can be improved upon over time. As the demonstration table is used ways of improving it will come up.

(c) **Construction:**
Construction not adjusted and aligned as suggested. The author insisted on the name Educational Mobile Laboratory even though another name "Science/Mathematics Mobile Demonstration Table" was suggested by the team of experts that assessed the table.

(d) **Working Principle:**
Could still not identify any principle even though no principle is required.

(e) **Effectiveness of the Kit:**
Effective only as a demonstration table.

(f) **Practicality:**
Can effectively be used as a demonstration table for Science and Mathematics at the Basic Education Level.

(g) **Ease of Set up during Demonstration:**
It can easily be set up.

(h) **Availability of Kit Parts:**
The parts are locally sourced and are readily available.

(i) **Use of Local Parts:**
Local parts are used for the table.

(j) **Appropriateness of Size of Kit:**
The kit was not brought for sighting. There is no way of knowing if suggested adjustments were made on the table.

(k) **If it is accompanied by a manual, is the manual good enough and for electrical/electronic materials, does it contain a circuit diagram?**

Manual has been improved upon. The experiments which the Science/Mathematics Mobile Demonstration Table can be used for under mathematics, chemistry, physics and biology were clearly stated.

(l) Are there other dangers you feel that could arise from the use of this material?
If the storage space is not compartmentalized with each item stored in a compartment of its own, contents will spill or get lost in the process of movement of the table.

3. LANGUAGE AND STYLE
English/Chinese, etc
Language and style are self explanatory.

4. METHODS
The method depends on the experiment being performed.

5. EVALUATION
Evaluation is possible.

6. SOME IMPORTANT QUESTIONS TO CONSIDER

(i) Does the kit as assembled conform to international standard? Yes/No
Yes

(ii) Are the components easy to assemble? Yes/No
Yes

(iii) Would it be easy for students to use the kit in the classroom/laboratory? Yes/No
Yes

(iv) Is the kit affordable to students? Yes/No
No

(v) How long can the kit serve?
10 years minimum if properly maintained.

(vi) Are the diagrams and/or photographs pertinent and functional? Yes/No
Not Applicable.

(vii) Does the author use clear, concise English? Yes/No
Yes, in the manual.

(viii) At what levels and in which subjects would the Teaching Aid be used to teach?
In Primaries 1 – 6 for Basic Science and Technology and in JSS 1 – 3 for Basic Science and Basic Technology.

(ix) Is the demand for a Teaching Aid of this type likely to increase? Yes/No
Yes

7. RECOMMENDATION OF ASSESSOR

Recommended as demonstration Table for Basic Science and Technology; Basic Science and Basic technology.

8. NAME AND SIGNATURE OF ASSESSOR

Dr. I. U. Nsehe

9. DATE: 1/7/2016

CERT. No. 001592

FEDERAL REPUBLIC OF NIGERIA

Certificate of Registration of Patent

(Patents and Designs Act; CAP 344 Laws of the Federation of Nigeria 1990)

RP: **NG/ P/2014/398**
Date of Patent: **23/12/2014**
Date of Sealing:**01/03/2016**

President of the Federal Republic of Nigeria and Commander-in-chief of the Armed Forces
MUHAMMADU BUHARI

Whereas a request for the grant of a patent has been made by **LAWAL SADIQ SIUS , FEDERAL UNIVERSITY OF TECHNOLOGY, MINNA , NIGER STATE, NIGERIA., C/O. NATIONAL OFFICE FOR TECHNOLOGY ACQUISITION AND PROMOTION (NOTAP), N0. 4, BLANTYRE STREET, WUSE II, ABUJA, NIGERIA.**

for the sole use and advantage of an invention for **SCIENCE EDUCATIONAL MOBILE INTERVENTION LABORATORY**

AND WHEREAS the Federal Government being willing to encourage all invention which may be for public good, is pleased to accede to the request:

KNOW YE THEREFORE, that I do by this Instrument give and grant unto the person(s) above named and any successor(s), executor(s), administrator(s) and assign(s) (each and any of whom are hereinafter referred to as the patentee) by special licence, full power, sole privilege and authority, that the patentee or any agent or licensee of the patentee may subject to the conditions and provisions prescribed by any statute or order for the time being in force at all times hereafter during the term of years herein mentioned, make, use, exercise and vend the said invention throughout the Federal Republic of Nigeria, and that the patentee shall have and enjoy the whole profit and advantage from time to time accruing by reason of the said invention during the term of twenty years from the date first above written on this Instrument: AND to the end that the patentee may have and enjoy the sole use and exercise of the full benefit of the said invention, I do by this Instrument strictly command all citizens of the Federal Republic of Nigeria that they do not at any time during the continuance of the said term either directly or indirectly make use of or put in practice the said invention, nor in anywise imitate the same, without the written consent, licence or agreement of the patentee, on pain of incurring such penalties as may be justly inflicted on such offenders, and of being answerable to the patentee according to law for damages thereby occasioned:

PROVIDED ALWAYS that this patent shall be revocable on any of the grounds from time to time by law prescribed as grounds for revoking patents granted by me, and the same may be revoked and made void accordingly:

PROVIDED ALSO that nothing herein contained shall prevent the granting of licences in such manner and for such they may by law be granted.

MADE this: *1st day of March, 2016*

William K. Amuga
.....
Registrar of Patents & Designs

CONTENT

TABLE OF FIGURES

Fig. 1: Photograph of the Mobile Laboratory with many Experimental Setups on Display.

PREAMBLE

This product relates to science educational demonstrations, experimentations, display and instructional material that aid the teaching and learning of sciences for schools particularly secondary schools in Nigeria so as to enhance qualitative and effective science education translating into a reduced situation of mass failures in NECO, WAEC, NABTEB, IJMB and UTME. It provides multifunctional interfaces for variety of experiments on single equipment and it auxiliaries. It is also useful in higher institutions of learning especially the lower levels whose foundation is predicated on the basic secondary scientific knowledge.

1.0 TECHNICAL BACKGROUND OF THE INNOVATION

In Nigeria, the use of practical supports for theoretical teachings of sciences had always been through the conventional laboratories which contain auxiliaries like retort stands, clamps, beaker, burette, ray boxes, pulley system and other experimental functionaries usually in small confinement that is not conducive and convenient enough for effective and participatory teaching and learning. This effort has made experimentation easier and more captivating by flexibly rolling the mobile laboratory around for appropriate purposes. The Science Mobile Laboratory has a lockbox with a locking device to keep all the auxiliary material safe.

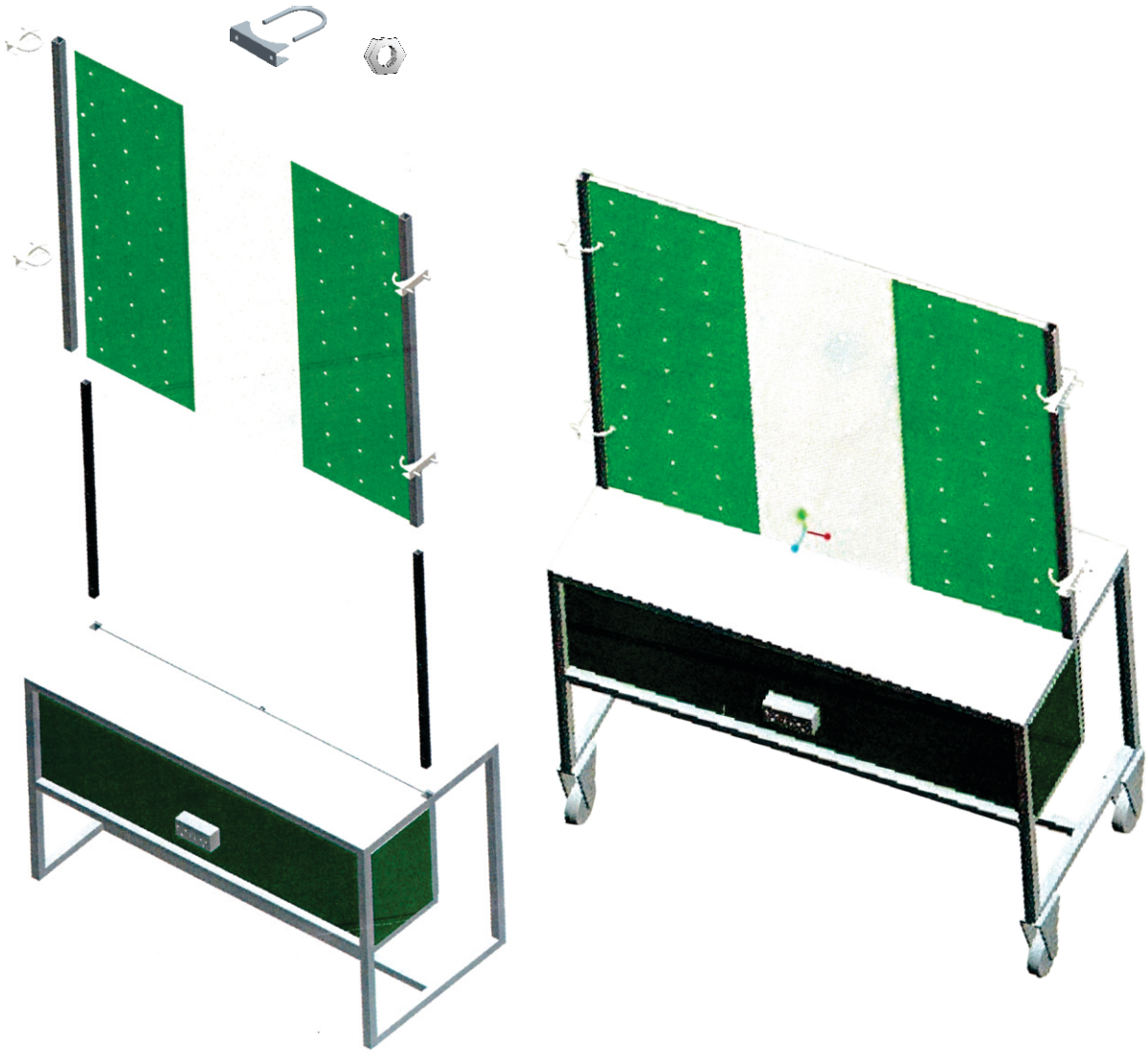

Fig. 2: Coupling of the Mobile Laboratory

2.0 OPERATIONAL NOTE

The equipment is improvised with customized accessories and auxiliaries such as protruding rod, clamps, perforated meter rule and pulleys. These accessories make the apparatus fit conveniently in aiding, teaching and learning of sciences in schools.

(A.) Protruding Rod (as shown in Fig. 3&5): The protruding rods are designed with bolt and nut arrangements to serve as rigid body and holding of pulley for any appropriate experiment. The protruding rod is used by protruding (fixing) it out through any of the holes provided in the board of the Mobile laboratory. The two nuts provided is to adjust how much the length of the rod comes out as desired and also to hold firmly the rod to the board by tightening the nuts from both sides of the board. See figures below:-

Fig. 3: The Protruding Rod

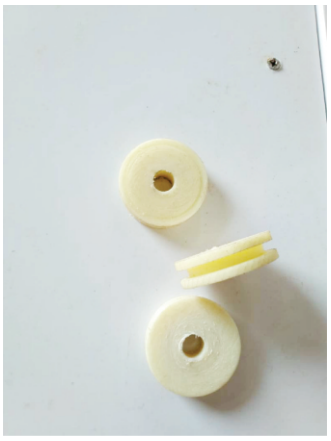

Fig. 4: The Pulleys

Fig. 5: The Protruding Rod on the Board with the Pulley

(B.) Improvised Clamps: This is a standard clamp threaded with nuts arrangement improvised on the board to perform any experiment that has to do with clamping just the way it is been used on the familiar retort stand. It is fixed on any of the holes of the board with a nut on both sides to adjust and or hold the clamp firmly on the board as shown in figures 5&6.

Fig. 6: The Threaded Clamp

Fig. 7: The Clamp on the Board Experimentation

(C.) Pulley: It was manufactured and customized to be used with this apparatus when there is need to carry out any experiment on pulley system as show in Fig. 4 and 5 above.

(**D.) Perforated Meter Rule:** The perforated holes are fixed on the protruding end of the protruding rod to perform experiments such as moment principle, measurement in Hooke's Law Experiment as shown Fig. 8, 12 & 14.

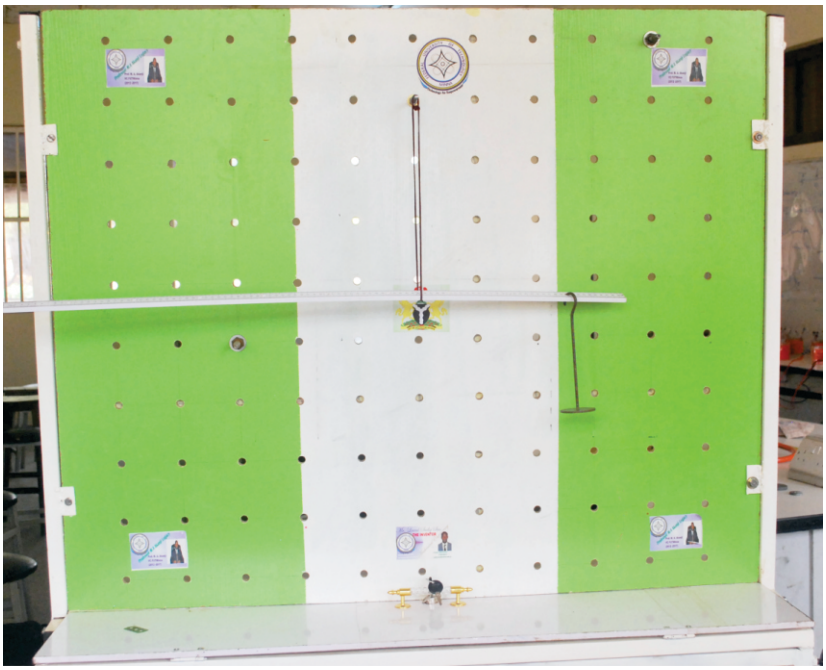

Fig. 8 : Moment Principle with Meter Rule

With these customized accessories improvised on the Mobile laboratory, many experiments as obtainable on the conventional laboratory can be performed as discussed below.

Fig. 9: Mathematical Shapes and Graphs on Display

3.0 SOME OF THE EXPERIMENTS THAT CAN BE PERFORMED ON THE SCIENCE MOBILE LABORATORY

Some of the experiments that can be performed on the equipment include the following:

3.1 Physics

1. Experiment to determine the weight, densities and relative densities of solid weight material like stone and liquid (kerosene) using the triangle of forces and Archimedes principles.
2. Experiment to determine the weight, densities and relative densities of solid weight material like stone and liquid (kerosene) using the Moment and Archimedes principles.
3. Experiments to determine the acceleration due to gravity (g) by means of (i) Simple Pendulum (ii) Compound Pendulum.
4. Experiment to determine the spring constant by (i) Extension (ii) Oscillation methods.
5. Experiments on Electricity, Optic and Light (Mirror and prism)
6. Experiment on Vectors, Triangle and resolution of forces Mechanics and Pulley system.
7. Display and explanations of some basic and Mathematical Concepts
8. Other experiments that depend on the creativity and critical thinking of both the teachers and students can be adopted and modified on the Experimental Board.

3.2 Chemistry

The two main experiments normally Performed in Chemistry are

1. **Quantitative Analysis (Titration):** Mounting the threaded clamps on the board to hold the burette for experimental set up as shown in Fig. 15.
2. **Qualitative Analysis (Working with beakers on the base/platform of the Mobile laboratory):** These experiments can easily and clearly be demonstrated for students in the classroom using the mobile laboratory has been discussed and illustrated pictorially in Fig. 20 and 21.

3.3 Biology

Experiment like Food tests and any other experiment that has to do with beakers and clamps can be demonstrated for students on the apparatus when being used in the classroom.

3.4 Mathematics

The teacher could adapt it for explaining Pythagoras theorem, Lami's Theorem, Shapes and Plotting of graphs etc. The use of masking tapes or white stickers could be used in tracing shapes and explaining graphs for students of basic sciences.

4.0 PROCEDURES AND PHOTOGRAPHS OF SOME OF THE EXPERIMENTS DONE ON THE APPARATUS ARE DESCRIBED BELOW:

4.1 PHYSICS

Experiment 1: SIMPLE PENDULUM (Fig. 10)

Materials required:

1. The Mobile Laboratory and its auxiliaries
2. String
3. Pendulum bob
4. Stop watch
5. Meter rule

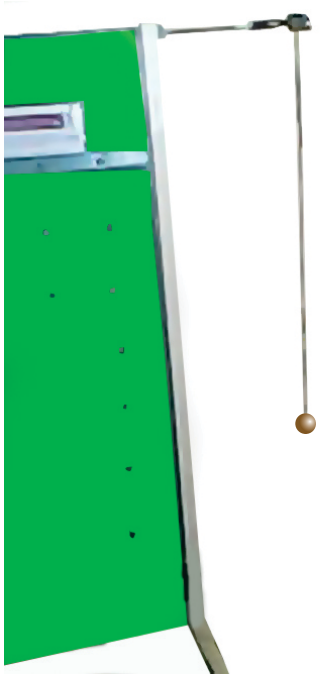

Fig. 10: Experimental Setup of Simple Pendulum using the Side Frame of the Mobile Laboratory

Fig. 11: Experimental Setup for Simple Pendulum

Procedures

1. Insert the protruding rod into any of the holes (see Fig. 11). 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

Experiment 2: COMPOUND PENDULUM (Fig. 12)

Materials required:

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

Fig. 12: Experimental Setup for Compounded Pendulum a & b

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

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

Fig. 13: Principle of Moment Experimental Setup

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.

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.

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

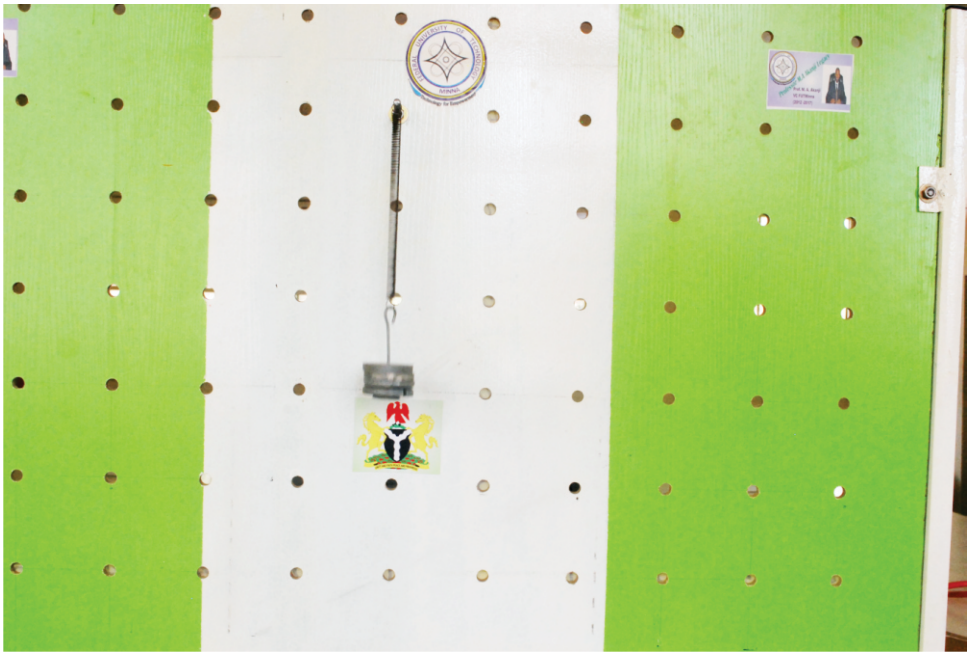

Fig. 15: Experimental Setup to Determine Spring Constant (Hooke's Law)

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.

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)

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

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

Experiment 2: SEPARATING FUNNEL (Fig. 17)

Materials required:

1. Mobile Laboratory
2. Improvised Clamp
3. Separating Funnel
4. Beaker
5. Liquid Mixture

Fig. 17: Experimental Setup for Separating funnel on the Mobile Laboratory

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. 17
2. Clamp the separating funnel vertically
3. Pour the liquid mixture to be separated into the separating funnel
4. Allow the mixture to settle and partition into two different layers
5. Place the beaker directly under the funnel outlet
6. Open the tap to collect the denser liquid
7. Close the tap immediately to retain the lighter liquid.

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

Experiment 4: FILTRATION (Fig. 19)

Materials required:

1. Mobile Laboratory
2. Funnel
3. Filter Paper
4. Beaker
5. Clamp

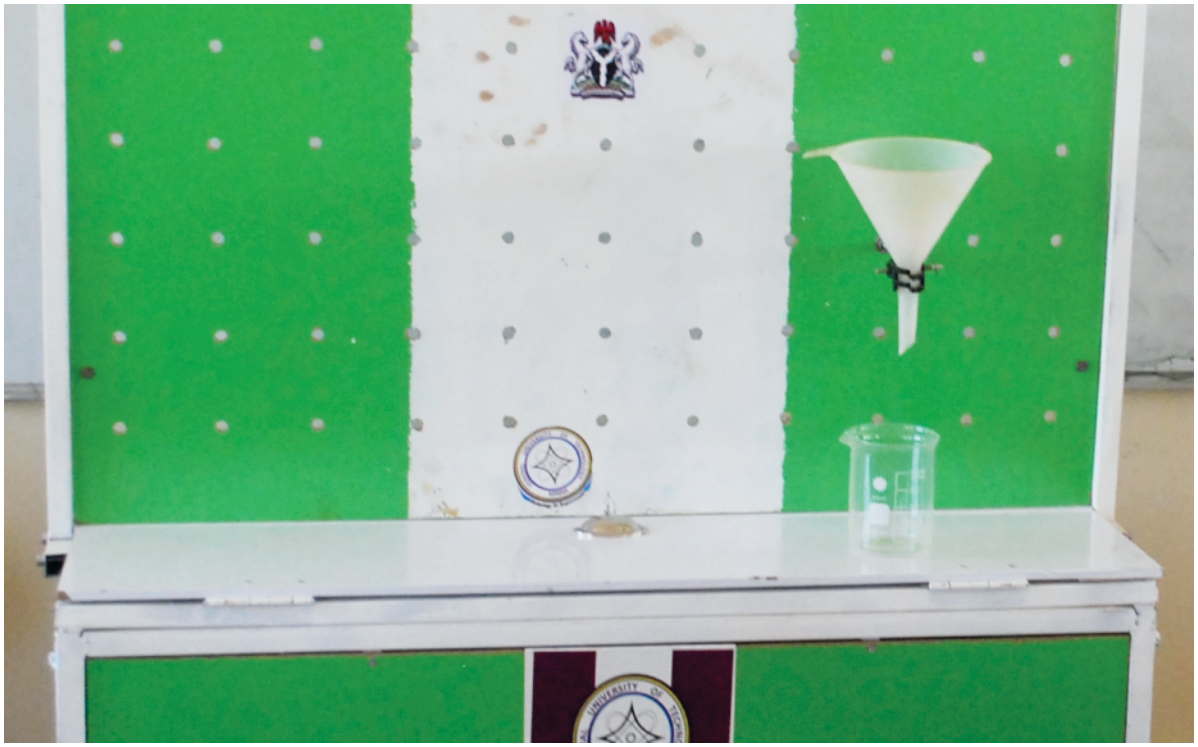

Fig. 19: Experimental Setup for Filtration on the Mobile Laboratory

Procedures

1. Improvise the clamp on the board
2. Clamp the funnel vertically
3. Fold the filter paper and place into the funnel
4. Place the beaker under the funnel
5. Pour the solid-liquid mixture into the funnel
6. Collect the filtrate in the beaker while the residue is being retained on the filter paper inside the funnel

Experiment 5: DETERMINATION OF PURITY (Boiling/Melting Point) (Fig. 20)

Materials required:

1. Mobile Laboratory
2. Improvised Clamp
3. Beaker
4. Boiling Tube
5. Thermometer
6. Stirred Rod
7. Wire Gauze
8. Tripod Stand
9. Bunsen Burner

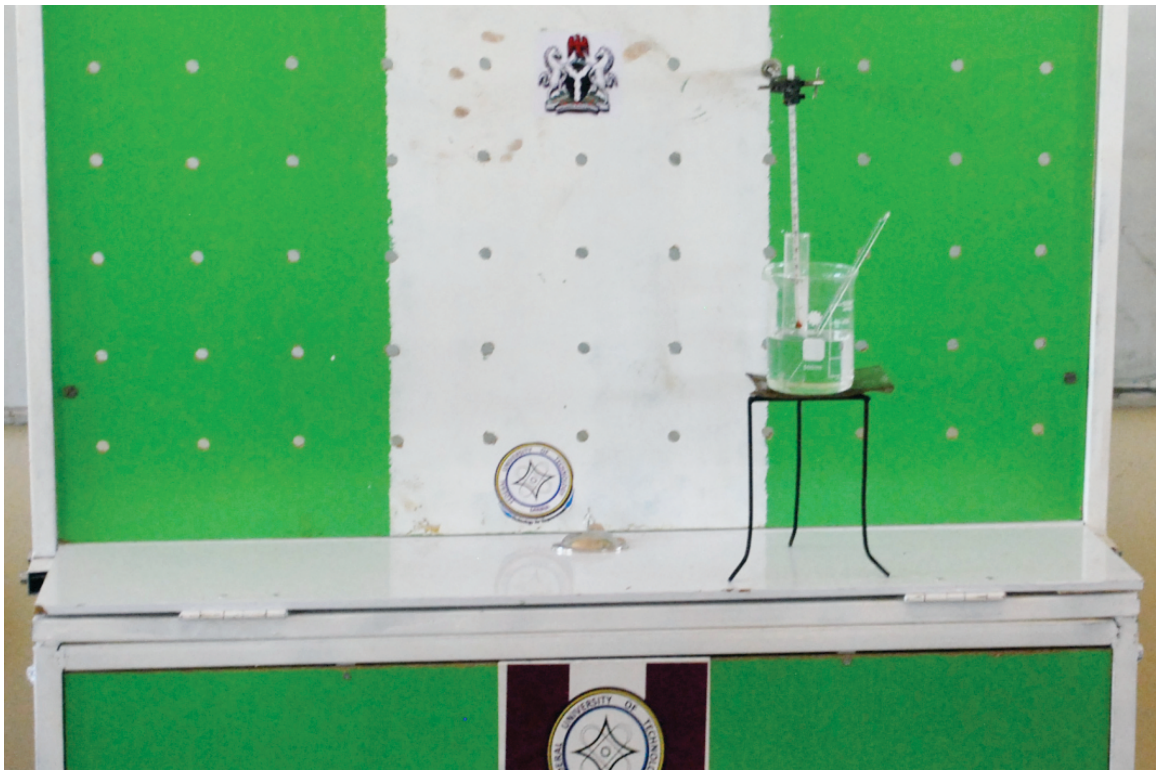

Fig. 20: Experimental Setup for Determination of Purity (Boiling/Melting Point) on the Mobile Laboratory

Procedures

1. Improvise the clamp on the board
2. Clamp the thermometer while its fitted into the boiling tube
3. Place the beaker on the tripod stand while the boiling tube and thermometer fits into it as shown in the fig. 20 Above
4. Light the Bunsen flame to heat the set up

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

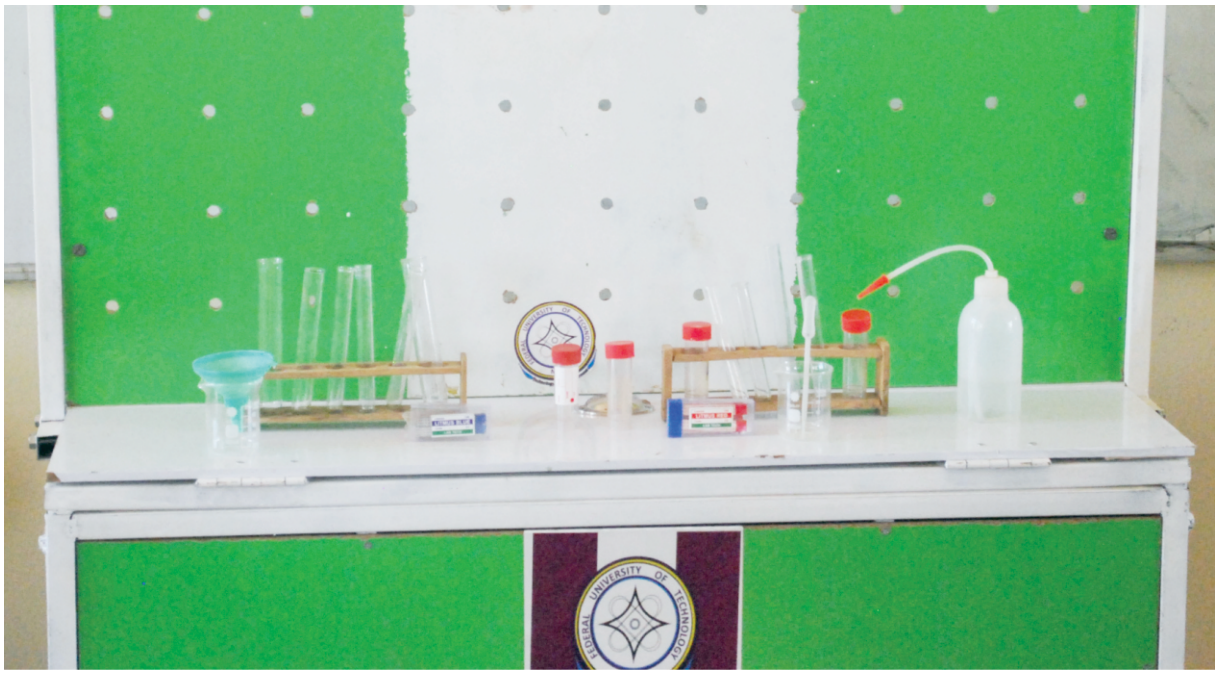

Fig. 21: Experimental Setup for Qualitative Analysis on the Mobile Laboratory

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

Experiment 7: LABORATORY PREPARATION OF GASES (Fig. 22)

Materials required:

1. Mobile laboratory
2. Kipp's Apparatus
3. Reagents/Chemicals

Fig. 22: Experimental Setup for Laboratory Preparation of Gases on the Mobile Laboratory

Procedures

1. Place the apparatus (kipps) on the base/ platform of the mobile laboratory
2. Add the reagent to the apparatus in the right proportion
3. Cork the apparatus
4. Monitor the reaction as it proceeds.

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)

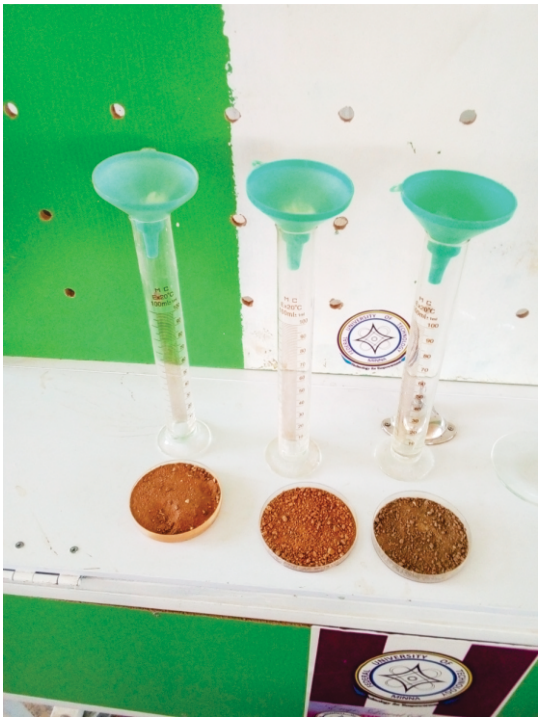

Fig. 23: Comparing the Water holding Capacity of Different Types of Soil. (Fig. 20)

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 ($50cm^3$) 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.

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

Fig. 24: Osmosis in Non-Living System

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.

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,
3. Copper (II) Sulphate Solution.

Fig. 25: Food Tests (e.g. Biuret Test)

Procedures

1. Place the rack on the mobile lab.
2. Put the test tubes inside the rack.
3. Pour small quantity ($2cm^3$) of egg white in one of the test tubes and add about $1cm^3$ 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.

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.

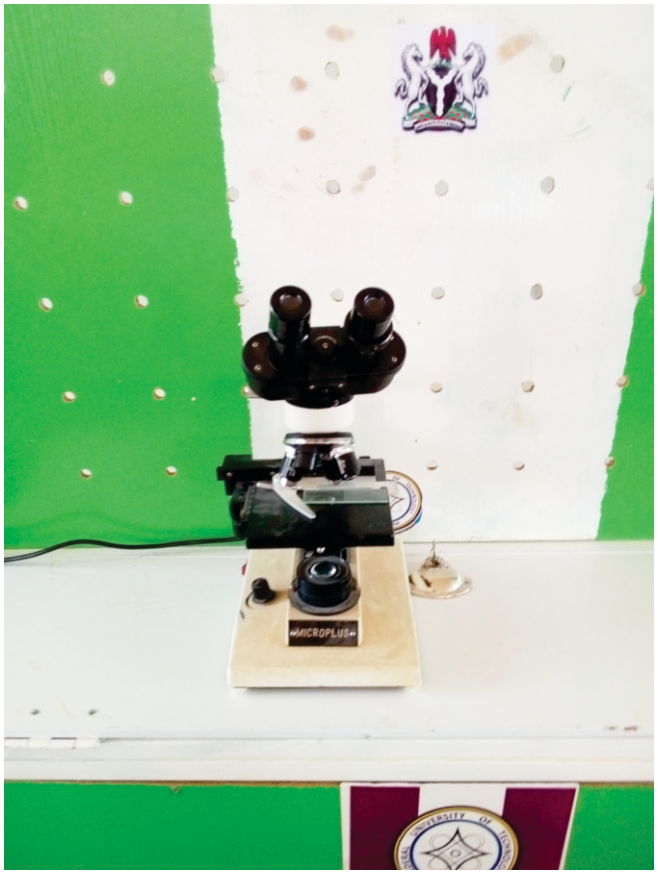

Fig. 26: How to use a Light Microscope on the Mobile Laboratory

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.

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.

Fig. 27: Mathematical Shapes and Coordinates on the Mobile Laboratory

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)

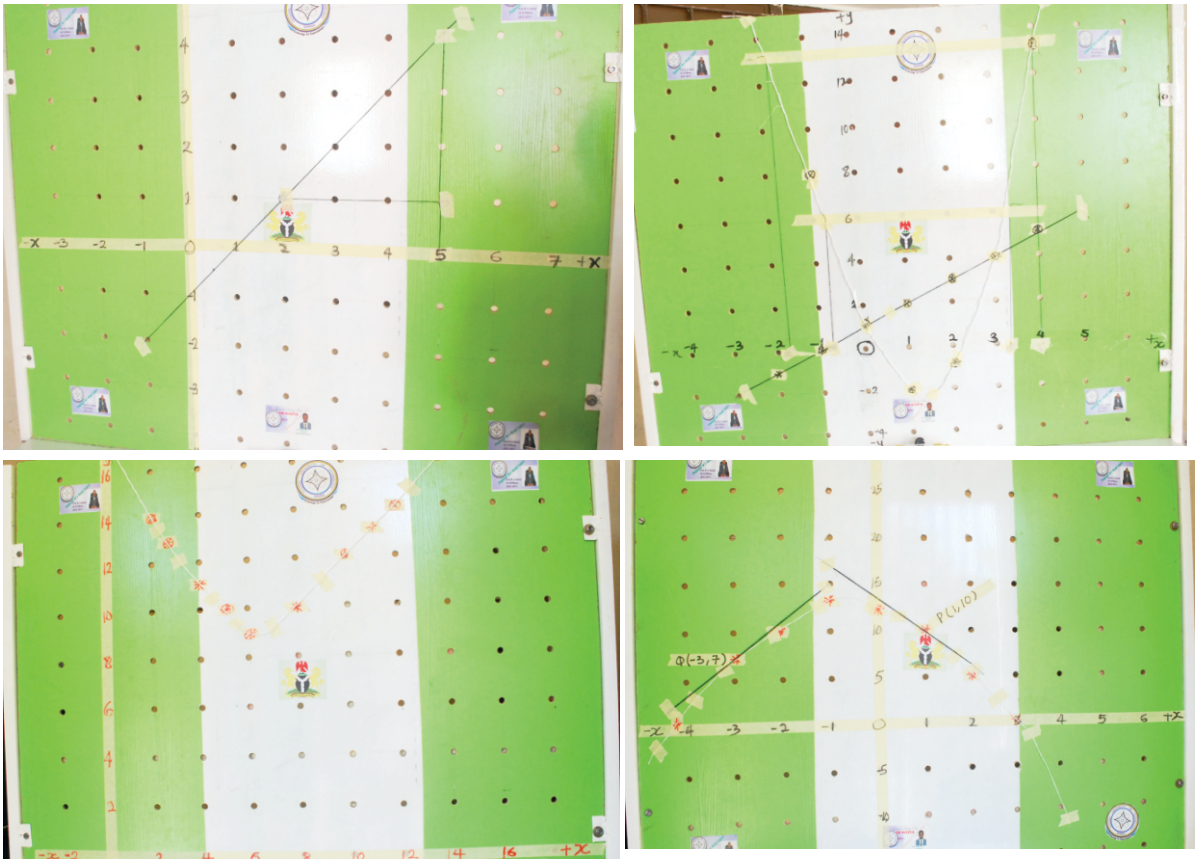

Fig. 28: Mathematical Graphs plotting on the Mobile Laboratory

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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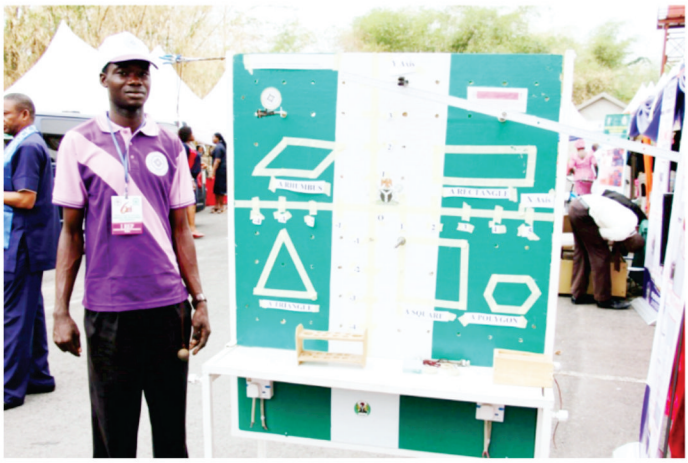
EXHIBITIONS



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