

Training Report for Secondary School Physics Teachers

Practical Work and Understanding of Physical Sciences at the Secondary Level in Niger

(Assembly, Disassembly, Use of Didactic Tests in Electricity-Electronics, and Implementation of Some Experiments)

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Discipline: Education Sciences - Specialty: Didactics of Physical Sciences.

Abstract:- This report discusses the use of experimental methods in the instruction of physical sciences and emphasizes its significance in gaining knowledge and skills. It also presents the training context for physical science teachers within the framework of my research project in science education.

The training aims to strengthen teachers' skills in experimental practice and help them illustrate teaching content through demonstrations and experimental manipulations in physical sciences field. This will assist teachers in the enhancement of their practice and make concepts more tangible for students.

The preliminary analysis of teachers' activities revealed that most of them recognize the color code of 4-band resistors, but modern devices use 5-band resistors. Therefore, it is important to encourage teachers to use 5-band resistors to stay up to date with new technologies.

A study was conducted on the use of breadboards in schools in the Region of Dosso, which is one of the country eight regions. The study outcomes were not mentioned, but the main objective was to evaluate how practical manipulations with breadboards contribute to students' understanding of concepts in physical sciences. Breadboards are commonly used tools for creating solderless electrical circuits and can be used in primary and secondary education.

Keywords:- Practical Work, Understanding, Physical Sciences, Secondary Level, Niger.

I. INTRODUCTION

Educational programs prioritize an experimental approach for scientific disciplines. This approach is not exclusive, and not all topics are suitable for its implementation. It is the responsibility of the teacher to determine which subjects will be presented through lectures

and which ones require an experimental approach. This approach is based on student questioning, real-world contexts, and problem-solving (mathematics). It results in gaining knowledge, methodological skills, and technical expertise.

This training is part of my doctoral research project in Education Sciences, specializing in Physics Didactics, with the theme "Practical Work and Understanding of Secondary Level Physical Sciences", and the title "Research on the Cognitive Contribution of Practical Work in the Understanding of Physical Sciences at the Secondary Level."

The beneficiaries of the didactic tests in Electricity-Electronics are the Physics teachers in CEG1 and CEG2 classes in the Region of Dosso. In order to provide the didactic materials to the Physics teachers, it is necessary for them to be trained in the use of these materials. The current title of the training is: "Assembly, Disassembly, Use of Didactic Tests in Electricity-Electronics, and Implementation of Some Experiments."

Didactic tests can contribute to the understanding of concepts and notions in Physical Sciences. The articles, namely "Teaching Physical Sciences: Pedagogical Practices" by Mostefa (2002) and "The Concepts of Science Didactics: Tools for Reading and Constructing Learning Situations" by Astolfi (1990), are relevant in supporting the analysis of pedagogical practices in teaching Physical Sciences and highlighting the importance of science didactics concepts in the construction of learning situations.

Mostefa's article emphasizes the pedagogical approaches used in teaching Physical Sciences and underscores that some of these approaches can make knowledge less comprehensible for learners. This has significant implications for how teachers convey scientific knowledge to learners and emphasizes the need to consider the pedagogical methods used.

Conversely, Astolfi's article emphasizes how concepts in science didactics contribute to the development of learning scenarios. It emphasizes that these concepts and tools can assist teachers in understanding and constructing effective learning situations for learners. By shedding light on the importance of science didactics, this article underscores the need to consider pedagogical methods and approaches based on these concepts to enhance the teaching of Physical Sciences.

By utilizing these articles as references, it is possible to support the analysis of pedagogical practices in teaching Physical Sciences and emphasize the significance of science didactics concepts in the construction of learning situations.

To sum up, didactic experiments can be pivotal in comprehending concepts and ideas in the field of Physical Sciences. Science didactics offers concepts and tools that can aid teachers in creating effective learning situations for learners.

A. Problem Statement

Presently, the growing significance of science and technology has resulted in regarding scientific education as a key challenge for the future development of a nation. Research in didactics has increasingly focused on science education, which means the need to provide young people with a basic science education to enable them to apply their knowledge in various contexts of their daily and social lives and to encourage them to pursue specialized studies in scientific or technical fields at higher levels (RAMIANDRISOA & ELO, 2020, p.167).

As a field of research, physics didactics is the activity of physicists who are interested in teaching their discipline. Far from being an applied psychology to the learning of physics, it can be defined as physics involved in the improvement of teaching (MARTINAND, 1986, p.891).

After a pilot survey aimed at collecting data and information from Physics advisors in the Dosso municipality (DOSSO1), laboratory technicians from the Dosso region, educational administrations, teachers, and students, the design of a battery can solve the problem of operating a breadboard. To manufacture the battery casing, we used 3D printing. The battery is readily available on the market. It is made of lithium.

"Innovation is crucial for any company that wants to grow and progress."

B. Training Objectives

➤ General Objective

- Develop didactic tests in Electricity-Electronics that take into account the theoretical model of scientific practical work in understanding concepts and notions in Physical Sciences.

➤ Specific Objectives

- Enhance the capacity and understanding of teachers in experimental practice.
- Illustrate the teaching/learning content through demonstrations and experimental manipulations in the understanding of Physical Sciences.

C. Participant Profile

The participants in this training are a group of ten (10) teachers, consisting of seven (7) men and three (3) women, with different academic backgrounds and professional experiences. All participants were ready to engage in exchanges and discussions about the tools and practices used, and they were capable of illustrating the teaching/learning content through demonstrations and experimental manipulations in the comprehension of Physical Sciences.

Regarding the subjects taught by the teachers in their institutions, seven (7) teach Mathematics/Physics-Chemistry (M/PC), two (2) teach Physics-Chemistry/Life and Earth Sciences (PC/SVT), and one (1) teaches Physical Sciences. Among these teachers, seven (7) are permanent teachers, and the remaining three (3) are contract teachers. (See Figure 1 and Figure 2 for more details).

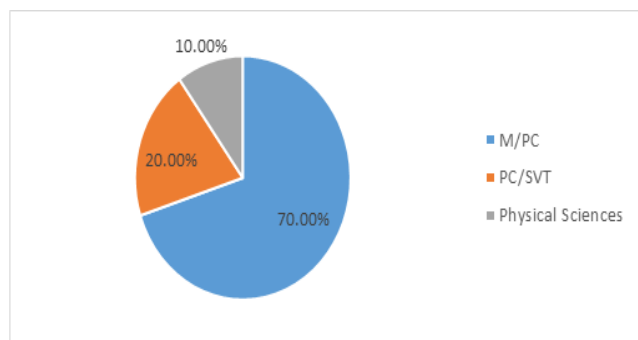


Fig 1 Disciplines Taught

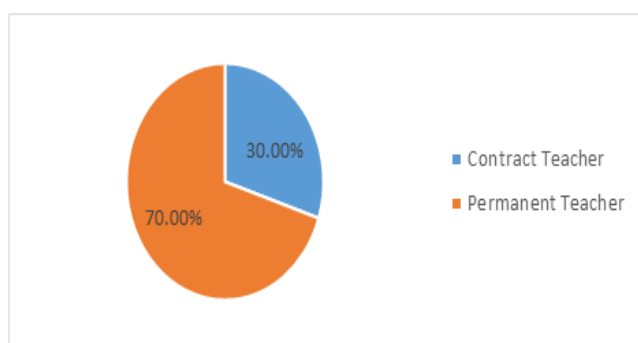


Fig 2 Teacher Status

Among the participants, eight (8) responded to the question regarding their university education. Among them, four (4) have obtained a Bachelor's degree (Maîtrise) as their highest degree, three (3) have obtained a Diploma from the École Normale Supérieure (ENS), and one (1) has obtained a Master's degree. These details are presented in Figure 3.

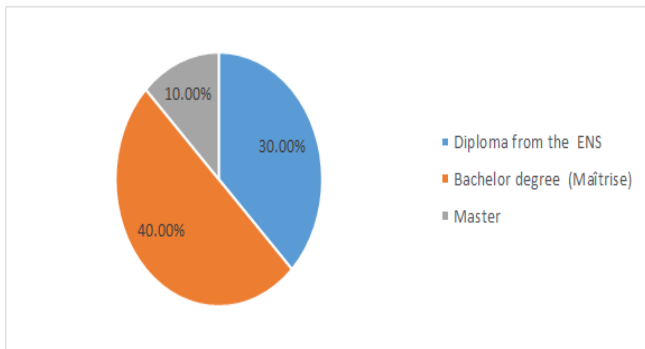


Fig 3 Academic Background of Teachers.

Among the ten (10) teachers, one (1) has a specialization in Physical Sciences, while the other seven (7) have different specializations, namely BAC+2, Geophysics, Management Informatics, Industrial Informatics, Agricultural Engineer, Telecom Engineer, and Life and Earth Sciences (Table 1).

It is indeed beneficial to provide training to these teachers, especially those who teach the discipline of Physical Sciences with different specializations. Such training would allow them to deepen their knowledge in Physical Sciences field and better integrate the specific concepts and practices of this discipline. This would contribute to improving their teaching and their ability to effectively convey the concepts and notions of Physical Sciences to students.

Table 1 Other Specializations of Teachers' Degrees (besides Physical Sciences)

Specialization	Frequency
BAC+2	1
Geophysics	1
Management Informatics	1
Industrial Informatics	1
Agricultural Engineer	1
Telecom Engineer	1
Life and Earth Sciences (SVT)	1

D. Training Procedure

The laboratory equipment management expert will conduct the training by providing theoretical knowledge and organizing practical activities to enhance the participants' skills. The training takes place at the LSM laboratory in Dosso.

During the training, the laboratory equipment management expert will guide the participants through practical exercises and discussions on topics such as breadboard usage, color code reading, series and parallel resistor connections, resistance measurements, and color code utilization. On the final day, the participants will become familiar with the identification of transistor pins (C, B, E) and will carry out a setup using a transistor and a photoresistor on a breadboard to simulate public lighting.

The training also includes breaks to allow participants to rest and recharge.

E. The Tasks We had to Perform During Teacher Training Included:

The materials used during the training include:

- **Multimeters:** They are employed for measuring diverse electrical parameters like voltage, current, and resistance.
- **Color-coded resistors:** These are resistors marked with color bands to indicate their resistance value in ohms. They are used in electrical circuits.
- **Connecting wires:** They are used to establish electrical connections between different components in circuits.
- **Breadboards:** These are boards with rows of holes to allow for the temporary assembly of electronic components. They facilitate experimentation and circuit testing.
- **Potentiometers:** These are variable resistors that allow for adjusting the resistance value in a circuit. They are often used to adjust voltage or volume levels.
- **Batteries:** They provide the necessary electrical power to experimental circuits.
- These materials are essential for practical exercises and demonstrations during the training on laboratory equipment management. They enable participants to become familiar with commonly used electrical components and acquire practical skills in handling and measuring electrical quantities.

➤ **The Training Scenarios**

• **Day 1**

The training scenario on the first day unfolds as follows:

Before the arrival of the teachers, the classroom was prepared by the lab technician from LSM High School. The room is clean and well-organized, and the necessary instruments for experimentation have been arranged into three groups on the laboratory benches. These groups consist of multimeters, color-coded resistors, connecting wires, breadboards, and potentiometers.

Prior to starting the activities, a Physical Sciences inspector is present, accompanied by the educational advisor who oversees the training. The doctoral student is also present as a supervisor. Each of them explains the training procedures to the participants.

There are ten (10) participants, including three female teachers and seven male teachers. It should be noted that the initial agenda included the training of thirteen (13) Physical Sciences teachers, but three individuals were absent. The participants, along with a Physical Sciences counselor, provided justifications for their absences.

The trainer distributes the experimental materials onto the three benches, thus forming three working groups. Each group will work with the aforementioned materials. They are as follows:



Fig 4 Types of Experimental Materials.

Indeed, to clarify the meaning of "efficiency," a practical task can be considered efficient at two levels. Level 1 corresponds to the "doing" level, where the practical task enables the accomplishment of a concrete activity. Level 2 corresponds to the "learning" phase, wherein the hands-on activity fosters understanding in both the realm of tangible items and observables, as well as in the realm of concepts." (Millar, 2004, p.9).



Fig 5 Laboratory work: Bridging Two Knowledge Domains.

In summary, practical work plays a crucial role in helping students establish a connection between the realm of observable objects and the realm of scientific ideas. They provide an opportunity for tangible and active learning, thus promoting a better understanding of scientific concepts and the development of scientific skills among students.

We provided the participants with the reference theory, model, and analytical framework to consider the efficiency of a practical task. Additionally, we also handed out the course on breadboards to the teachers, highlighting the key points within our theoretical framework. These presentations were conducted by the trainer to the participants before proceeding to the practical tasks. This allowed the teachers to familiarize themselves with the following definitions: What is a breadboard? And how to use a breadboard.

During the teacher training, we performed the tasks that aimed to verify the physical laws and equations in accordance with the requirements of physical sciences regarding reflection.

- ✓ Task 1: Place a 15 K Ω resistor, R1, and another variable resistor, R2, in series. Power the circuit with a generator and vary the current intensity.
- ✓ Task 2: Place a variable resistor on a breadboard, with R1 fixed at 10 K Ω . Vary the value of R2.
- ✓ Task 3: Place the same resistor on the breadboard, while keeping R1 fixed at 10 K Ω . Vary the value of R2.
- ✓ Task 4: Verify the following relationship: $U = U_1 + U_2$ using the specified setup on the breadboard.
- ✓ Task 5: Implement the circuit on a breadboard and verify that the voltage U remains constant.

These practical tasks allowed for the application of the covered theoretical concepts and the experimental verification of principles regarding physical laws and equations. They contributed to strengthening the participants' understanding and familiarizing them with concrete manipulations in the field of electrical circuits.

- *Day 2*

The second day of the training proceeded as follows:

We also had the same 10 participants, including three female teachers and seven male teachers, divided into three groups based on their choice.

We provided the teachers with a lesson on resistor color codes. The trainer delivered a brief course on precision resistors and the color code used by both electronics professionals and hobbyists in electronic circuit design. This allowed the teachers to acquire knowledge on reading color codes, particularly concerning 4-band resistors and precision resistors with 5 or 6 bands.

The practical tasks for this day were as follows:

- ✓ Color code reading: Teachers were given exercises to practice reading the color code of resistors and be able to identify the resistor values based on the color bands.
- ✓ Comparison between measurements and color codes: Teachers were required to measure resistances using measuring devices and compare the measured values with those indicated by the color code.
- ✓ Resistance measurement exercises and use of color codes: Teachers had to perform various practical exercises involving resistance measurements and the use of color codes to determine the values.
- ✓ The objective of these tasks was to reinforce the understanding and application of resistor color codes, as well as develop skills in resistance measurement. The teachers had the chance to apply their knowledge and improve their proficiency in this particular field.

- *Day 3*

The objective of the third day of the training was to motivate the teachers to engage in research. The same participants from the second day were present, including three female teachers and seven male teachers.

The day started with a general knowledge session, covering topics such as the usefulness of photoresistors and the use of Arduino in various electronic projects.

The practical tasks for this day were as follows:

- ✓ Identification of transistor pins (Collector, Base, Emitter): Participants had to learn how to identify and differentiate the different pins of a transistor.
- ✓ Assembly of a transistor and a photoresistor on a breadboard: Participants had to create a practical circuit using a transistor and a photoresistor, simulating a public lighting circuit.

These activities aimed to encourage participants to further explore research and develop their practical skills in electronics. By providing them with the opportunity to work with real components and perform concrete assemblies, we hoped to stimulate their curiosity and creativity in the field of electronics.

F. Processing Images of Training Photos

As part of our project, we focused on processing images of several photos using MATLAB. We took multiple shots for this purpose. To begin, we explored the characteristics of these photos by reading them using MATLAB code.

Before launching the MATLAB software, we created a folder on our computer desktop where we saved all the photos that we will be processing using MATLAB. Then, with the help of MATLAB, we can read and display an image using MATLAB code (see Appendix).

- *The Photo of the Laboratory Expert on the First Day (Named "Photofor 1.jpg").*



Fig 6 Image "Photofor 1.jpg".

On the first day of the training, the expert is conducting a verification of the experimental devices. In the photo, we can see various elements that are used in the experiments. Here is an educational explanation of these elements:

- Resistor color code kit: This is a set of resistors with different values that are identified by color codes. Resistors are used to control the electric current in a circuit.
- Power supply battery: It is a source of electrical energy. The battery provides an electrical voltage that powers the experimental devices.
- Multimeter: It is a versatile device for electrical measurements, capable of assessing different electrical parameters like voltage, current, and resistance. It is used to perform precise measurements in experiments.
- Male and female wires: These are electrical cables used to connect the different components of a circuit. Male wires have one end with a pin, while female wires have one end with a socket. They facilitate electrical connections during experiments.
- Photoresistor: It is a light-sensitive electronic component. The resistance of the photoresistor varies based on the intensity of light it is exposed to. It is used in experiments related to light detection or measurement.

In summary, the photo shows the different elements used in the experiments. These elements, such as resistors, the power supply battery, the multimeter, wires, and the photoresistor, are essential for understanding and conducting experiments in the field of electricity and electronics.

- *The Photo of the Trainer Expert on the Second Day (Named "Photofor 2.jpg").*



Fig 7 Image "Photofor 2.jpg".

In the photo of Figure 7, we can see the expert reading the color code on an electronic component. Here is an educational explanation of this situation:

When working with electronic components such as resistors, it is common for them to be marked with a color code. This color code is used to indicate the value of the resistor.

The color code consists of bands of different colors that are printed on the resistor. Each color corresponds to a specific digit. By combining the colors, we can determine the value of the resistor.

The expert in the photo is reading this color code to identify the value of the resistor. They are carefully examining the different color bands and using their knowledge to interpret these codes.

Learning how to read the color code is important in the field of electronics as it allows us to select the appropriate resistor for a given electrical circuit. It also helps in understanding and analyzing electronic circuit schematics.

In summary, the photo shows the expert reading the color code on an electronic component. Reading the color code is an essential skill in the field of electronics as it allows for precise determination of resistor values.

➤ *Photo (Taken "Photofor 3.jpg")*



Fig 8 Image "Photofor 3.jpg".

The teachers have created an electrical circuit on a breadboard. Here is an educational explanation of this situation:

The teachers assembled the necessary components to form an electrical circuit on the breadboard. They likely used components such as resistors, conductive wires, a power supply battery, and possibly other components depending on the circuit's objective.

Once the circuit is assembled, the teachers proceed with measurements. This may include measuring the voltage at different points in the circuit using a voltmeter, measuring the current intensity using an ammeter, or other specific measurements based on the circuit's objective and the knowledge the teachers aim to convey.

This hands-on experience with the electrical circuit on the breadboard allows the teachers to visualize and experiment with the basic principles of electricity. It also enables them to develop practical skills by constructing and measuring real circuits.

In summary, the teachers have built an electrical circuit on a breadboard powered by a battery. They then proceed with measurements to study the electrical properties of the circuit. This practical experience allows the teachers to explore and understand electricity concepts in a concrete and interactive manner.

➤ *Photo (Taken "Photofor 4.jpg")*

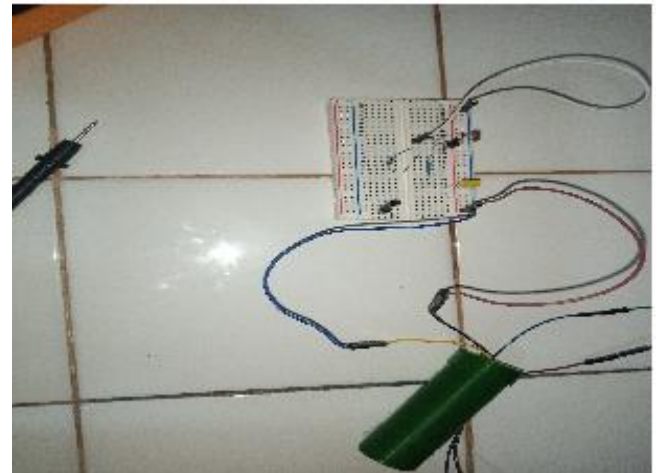


Fig 9 Image "Photofor 4.jpg".

As part of their teaching, the teachers created a public lighting system using a breadboard. Here is an educational explanation of this situation:

The teachers used the breadboard to construct a public lighting system, simulating the functioning of a lighting network in a street or public space.

To build this lighting system, the teachers employed various electronic components such as LEDs (light-emitting diodes), resistors, conductive wires, and possibly other components depending on the complexity of the system.

The teachers connected the LEDs on the breadboard, using appropriate resistors to control the current and prevent any damage to the LEDs.

Once the lighting system was assembled, the teachers were able to test it by supplying power to the circuit, such as through a battery. This allowed them to observe the LEDs lighting up, thereby simulating public lighting.

This hands-on experience with the public lighting system created on the breadboard enables the teachers to illustrate the fundamental principles of electric lighting. They can explain to students how LEDs function, how circuits are constructed to regulate them, and how real-world public lighting systems are designed.

In summary, the teachers utilized a breadboard to construct a public lighting system using LEDs, resistors, and other electronic components. This practical experience allows students to comprehend the concepts of electric lighting and visualize the operation of a public lighting system in a tangible and interactive manner.

➤ Photo (Taken "Photofor 5.PNG")

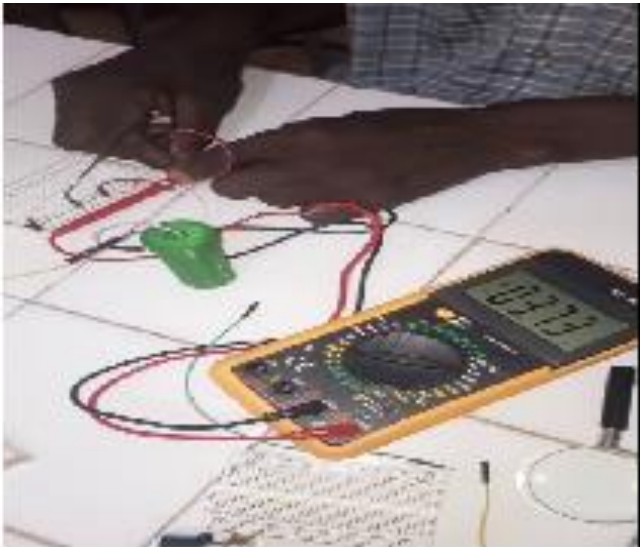


Fig 10 Image "Photo for 5.PNG".

In this situation depicted in Figure 10, a teacher is testing the electrical circuit alone and conducting measurements to assess the quality of the materials provided by the doctoral student. Here is an educational explanation of this situation:

The teacher assumes the role of a tester or evaluator to verify the quality of the materials supplied by the doctoral student. The goal is to ensure that the electronic components and equipment used in the circuit are functional and meet the required specifications.

To accomplish this, the teacher performs measurements on the electrical circuit. This may include measuring voltage, current intensity, resistance, or other electrical quantities at different points in the circuit using measuring instruments like a voltmeter, an ammeter, or a multimeter.

By conducting these measurements, the teacher can identify potential issues such as incorrect values, abnormal fluctuations, or defects in the components. These measurements help assess the quality of the materials provided by the doctoral student and ensure that the circuit is functioning correctly.

Through these tests and measurements, the teacher can also identify any potential improvements or adjustments needed to optimize the circuit's performance.

This activity allows the teacher to gain practical experience and develop skills in evaluating electronic materials. Furthermore, it provides an opportunity to explain to students the importance of testing and measuring electrical circuits to ensure their proper functioning and compliance with standards.

In summary, the teacher tests the electrical circuit alone and performs measurements to assess the quality of

the materials provided by the doctoral student. These measurements help detect potential issues and ensure the circuit's proper functioning. This hands-on experience enhances the teacher's skills in evaluating electronic materials and allows for the transmission of the importance of testing and measurements in the field of electronics to the students.

G. Summary of Training Evaluation

The training on teaching/learning electricity in the classroom was conducted very satisfactorily throughout the period. The participants showed great interest and were actively engaged in the discussions and activities provided.

The trainer successfully captivated the participants' attention by presenting the various topics related to electricity in a clear and concise manner. The exchanges between the trainer and the participants were dynamic and rich in sharing experiences and ideas. Participants were able to ask questions and receive clear and detailed answers, which contributed to deepening their understanding.

One aspect that was particularly appreciated in the training was the application of acquired knowledge through hands-on practical work. Participants had the opportunity to manipulate electrical equipment, conduct experiments, and observe electrical phenomena in action. This allowed them to better grasp the theoretical concepts and think about more interactive and experimental teaching methods.

The exchanges and sharing of experiences among the participants were also highly beneficial. Each person was able to contribute their own expertise and innovative ideas to enrich the pedagogical approach to teaching electricity. This fostered a collaborative and stimulating environment that was conducive to mutual learning.

In summary, the training on teaching/learning electricity in the classroom has been a highly positive experience. The participants demonstrated strong commitment and genuine interest in the topics discussed. The exchanges, hands-on practical work, and sharing of experiences have contributed to enhancing the participants' knowledge and skills in this field.

H. Evaluation of the training

All the educators concur that the training program is in accordance with the analytical framework used to evaluate the efficacy of a practical assignment (Abrahams & Millar, p.1949).

The overall objective of the training is as follows:

- Teachers will understand simple electrical circuits according to a scientific model.
- Teachers will become familiar with practices that promote understanding of concepts and principles in Physical Sciences.

In the survey, 20.00% of the participants responded "Yes" regarding activities to add or remove (Figure 11).

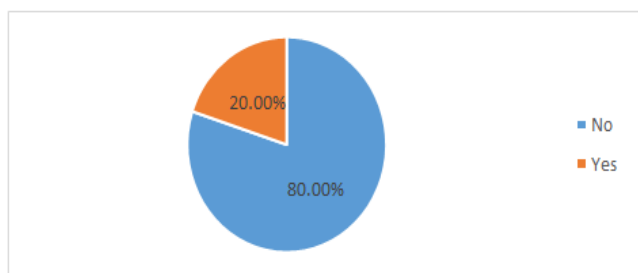


Fig 11 Response Rates for Activities to Add or Remove.

Here are the additional suggestions made by two teachers (Table 2):

Table 2 Suggestions for Additions by Two Teachers.

1	Suggestions for additions: - Experiment to trace the characteristic of a conductor. - Study the functioning of a battery.
2	Suggested addition: Activity sheet with clear and precise tasks.

These suggestions are additional elements proposed by the teachers to enhance the training and activities related to electrical circuits.

The teachers evaluated the learning process positively, expressing opinions such as "Acceptable," "It is reasonable," "The training is innovative: Everything is reasonable," "Reasonable," and "Everything is reasonable." These evaluations indicate that the teachers consider the learning process to be satisfactory and suitable for their needs.

According to the teachers, there are no contradictions or obstacles related to the training, and the participating teachers kindly provided these general comments. Here is a description and analysis of the content:

- "This training is very useful for teachers, and we would like the government to consider training teachers in practical activities."
- This comment highlights the usefulness of the training for teachers and expresses the wish that the government prioritize training teachers in practical activities.
- "For the smooth running of practical work in physics, laboratories must be equipped with suitable materials to enable students to be interested in Physical Sciences at the secondary and higher levels."
- This comment emphasizes the importance of equipping laboratories with appropriate materials to facilitate the smooth implementation of practical work in physics and to generate students' interest in Physical Sciences at the secondary and higher levels.
- "The training is innovative because everything necessary is provided to carry out all the planned experiments."
- This comment acknowledges the innovative nature of the training and highlights the availability of all the necessary resources to successfully conduct all the planned experiments.
- "No comment."

- This comment indicates that a person did not provide any specific comment.
- "The training has been very beneficial for teachers. We have benefited from this training, and the practical approach is innovative. It should be implemented in all secondary schools."
- This comment expresses the teachers' satisfaction with the training, emphasizing its benefits, and recommending its implementation in all secondary schools.
- "We hope that training can be organized on other parts of the curriculum, especially in optics."
- This comment expresses the desire for additional training to be organized, with a focus on addressing other aspects of the curriculum, particularly optics.
- "I suggest organizing additional training sessions on different topics so that teachers can fully grasp the practical aspects and effectively teach them."
- This comment proposes the organization of additional training sessions on different topics to enhance teachers' understanding of practical aspects and their ability to effectively teach them.
- "We have learned a great deal from this training. The training is innovative, and we have benefited from the teaching materials provided to conduct experiments with students."

This comment reflects the significant learning experience of the teachers during the training. It highlights the innovative nature of the training and acknowledges the use of teaching materials to conduct experiments with students.

Overall, the comments reflect a positive evaluation of the training by the participating teachers. They emphasize the training's utility, the importance of appropriate resources and equipment, and the need for additional training on various topics. The teachers also express enthusiasm for innovative approaches and their willingness to enhance their practical skills to improve the teaching of physical sciences.

In this study on the understanding of Physical Sciences and Practical Work, you organized a training for teachers from two schools (CEG₁ and CEG₂) in Dosso. According to Hassan, the laboratory manager at LSM, you observed that "with limited resources, one can accomplish a lot."

Teachers are advised to engage in scientific practical work to deepen their comprehension of concepts and subjects in the field of Physical Sciences. We recommend that the Ministry of Education may regularly offer training to teachers on experiment procedures based on the curriculum modules. This would strengthen teachers' confidence in implementing experiments.

These proposals highlight the significance of Practical Work in the instruction of Physical Sciences. Despite limited resources, you have observed that it is possible to achieve a great deal. However, you also emphasize the need for ongoing training for teachers to help them effectively utilize Practical Work in their teaching. This would enhance

teachers' confidence in conducting these experiments and integrating them meaningfully into the curriculum.

In summary, you have identified the potential of Practical Work in Physical Sciences and propose measures such as regular teacher training to enhance their skills in this area. These initiatives aim to enhance the instruction and comprehension of Physical Sciences in the relevant schools.

I. *Expected Training Results*

The expected outcomes of the training are as follows:

- Strengthening teachers' skills in experimental practice.
- Teachers' ability to illustrate teaching/learning content through demonstrations and experimental manipulations in the context of teaching Physical Sciences.

These results aim to improve teachers' competence in implementing practical work and experiments in the classroom. Through this training, teachers will be able to enhance their experimental practice, allowing them to concretely illustrate the concepts and content of Physical Sciences during their classes. The demonstrations and experimental manipulations will assist students in better understanding scientific concepts and developing their practical skills.

J. *Preliminary Analysis of Teachers' Activities*

The explanations provided by the trainer during the training regarding the color code.

Currently, there are resistors with color codes ranging from 4 to 5 bands. Teachers are most familiar with the 4-band color code.

The issue, therefore, lies in the lack of guidance because during the training, we informed the teachers that the books we use have resistors with colors that we have been using for a long time, where two colors represent the unit and the tens, the third represents a power of 10, and the fourth represents tolerance. However, if we look at modern devices today and are asked to determine the value of the resistor, we do not find these types of resistors.

This is because the system changes, science evolves, and Physical Sciences are subjects that do not remain stagnant; they evolve with time. "Science is constantly evolving." Let us evolve with it!

Teachers do not have a choice; they have been neglected when it comes to updating their knowledge to keep up with the advancements in science. This is the objective of the training regarding resistors' color codes.

Therefore, it is essential to encourage teachers to use 5-band resistors because there are no longer devices that use 4-band resistors.

K. *Study of Practices and Challenges in Teaching Physical Sciences: The Use of Breadboard in Dosso Schools.*

The research presents some limitations, even at the scale of students in the Dosso commune. We sought the participation of two volunteers, teachers, to implement identical scenarios with the students. We collected data, including Student Practical Work, to evaluate how practical experiments contribute to students' understanding of concepts and notions in physical sciences. We worked with two teachers from CEG₁ and CEG₂ schools, with a total of 98 students, compared to a total population of 3,947 students in these two schools, representing a rate of 2.48%. Additionally, we considered a population of 19,096 students from IESG (General Secondary Education Inspection of Dosso), including other schools, which corresponds to a rate of 0.51%.

Regarding these rates, claiming a definitive conclusion would be audacious. However, our research methods are applicable and rigorous. Our interest does not lie in the rate itself, as our research study is costly. Our main objective is to study how students perform practical manipulations. As described in the theoretical framework, the breadboard is a widely used tool in fields such as scientific research and robotics. Every teacher should be able to position components on the breadboard and perform the corresponding measurements. The breadboard is a simple device designed to facilitate the creation of circuits without requiring soldering.

In summary, the breadboard can be used to implement all electrical and electronic circuits in the first cycle, from 6th to 3rd grade, as well as in the second cycle, including 10th-grade sections A and C, 11th-grade sections A, D, and C, and 12th-grade sections C, D, and E, within the framework of teaching in the Nigerian secondary cycle.

II. CONCLUSION

In summary, this report emphasizes the significance of employing an experimental approach in the instruction of physical sciences and its critical role in students' attainment of knowledge and skills. The training offered to teachers aims to strengthen their practical skills and facilitate the illustration of teaching content through demonstrations and experimental manipulations. This approach will enable teachers to improve their pedagogical practice and make scientific concepts more tangible for students.

The preliminary analysis of teachers' activities revealed a specific challenge related to recognizing the color code of resistors. To stay up to date with new technologies, it is essential to encourage teachers to use 5-band resistors, which are commonly used in modern devices. This will ensure that students are familiar with current practices in physical sciences field.

Furthermore, a study on the use of breadboards in Dosso schools was conducted, although the results were not mentioned in this report. The primary aim of this study was

to assess how practical manipulations with breadboards contribute to students' understanding of physical science concepts. The breadboard is a valuable tool for creating solderless electrical circuits, and its use can be beneficial in both primary and secondary education.

In summary, the proposed training and the study on the use of breadboards results emphasize the importance of promoting a practical and experimental approach in teaching physical sciences. This will allow students to cultivate a more profound comprehension of scientific concepts and refine their practical skills in this domain.

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APPENDIX

The images we used are as follows: "photofor1.jpg", "photofor2.jpg", "photofor3.jpg", "photofor4.jpg", and "photofor5.PNG".

The opening and reading of the images can be done using the following MATLAB code:

Here is the MATLAB code for reading and processing each image:

```

```MATLAB
% Specify the directory path where the images are located
path_to_directory = 'path_to_directory';
% Read and process each image
image_filenames = {'photofor1.jpg', 'photofor2.jpg',
'photofor3.jpg', 'photofor4.jpg', 'photofor5.PNG'};
for i = 1:numel(image_filenames)
 % Construct the full file path
 image_filepath = fullfile(path_to_directory,
image_filenames{i});
 % Read the image
 image = imread(image_filepath);
 % Process the image as needed
 % ...
 % Your image processing code goes here
 % Display the processed image
 figure;
 imshow(image);
 title(sprintf('Processed Image %d', i));
end
```

```

Please replace `path_to_directory` with the appropriate directory path on your computer.

```

clear all;
close all;
img= imread ('nom.image');
imshow (img)

```

Please make sure to modify the directory path (`path_to_directory`) with the appropriate path on your computer. You can execute this code in MATLAB to open and process the mentioned images.