UNIVERSITY FOR DEVELOPMENT STUDIES, TAMALE

IMPROVING THE PERFORMANCE OF FORM-THREE STUDENTS OF SAVELUGU MUNICIPAL ASSEMBLY JHS 'B' IN MEASURING SOME PHYSICAL QUANTITIES USING THE ACTIVITY-ORIENTED TEACHING METHOD

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BY

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DECLARATION

Candidate's Declaration

I hereby declare that this dissertation submitted is the result of my work and that no part of it has been presented for another degree in this university or elsewhere.

I however acknowledge all sources of secondary materials used by duly referencing the sources in accordance with the American Psychology Association (APA) system of referencing.

Student's Name: IDDRISU DOKURUGU   Student's ID: UDS/MTD/0065/15

Signature: ....   Date: ....

Supervisor's Declaration

I hereby declare that the preparation and presentation of this dissertation was supervised by me in accordance with the guidelines on supervision of thesis laid down by University for Development Studies.

Supervisor's Name: DR. ANTHONY K. DONKOR

Signature: ………………………...   Date: …………………………

ABSTRACT

Measurement of physical quantities is an indispensable discipline in man's daily activities. Unfortunately, the performance of some form-three students of Savelugu Municipal Assembly Junior High School in measurement of physical quantities needs much to be desired. The purpose of this study was to improve the performance of the students in measuring physical quantities using the activity-oriented method of teaching/learning. Action research design was adopted in this study. Simple random sampling technique was used to select the sample for the study. Written tests, questionnaires, and observation guide were used to collect data on participants. Participants were engaged in series of activities in measuring given physical quantities. Data was analysed and presented in simple tables. The research findings indicated that participant's inability to understand the concepts and acquire the skills of measuring physical quantities was attributed to: teaching the topic without the appropriate teaching/learning materials, using inappropriate teaching method in treating the topic, and lack of interest in the topic on the part of some students. It was recommended that stake-holders should support schools with teaching/learning materials. Also, teachers should make good use of teaching/learning materials.

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DEDICATION

I dedicate this work to my wife, who did not only give me moral support but also took over the managerial duty of my family during the course of the research work.

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CHAPTER ONE

INTRODUCTION

1.0 Introduction

It is indisputable fact that quality education is essential in man's total development. Unfortunately, the standard of education at the basic level in some parts of Ghana, of late, needs much to be desired. It is common knowledge that the performance of students in the basic education certificate examinations in some parts of the northern region of Ghana has not been encouraging. This study aims at fixing an identified learning problem in the classroom using appropriate methodology and approaches. This chapter contains background to the study, statement of the problem, purpose of the study, research questions, research objectives, significance of the study, delimitation, limitations and organization of the study.

1.1 Background of the Study

Measurement of quantities is very important in our daily live situations. Therefore, it is not for nothing that measurement of quantities such as length; area; temperature; weight; and mass among others are included in the country's educational curricula. Carpenters, dress makers, engineers, traders, sports men and women, farmers, among others use at least one of those quantities in their activities on daily bases.

Accurate measurement is paramount in minimizing cost, cheating, accidents and loss of lives at various work places. For instance, health workers need to measure accurate doses of medicine and vital signs (weight and temperature) of patients to avoid overdose or under dose in order to ensure proper treatment. In the same vein, surgeons need to take accurate measurement in carrying out surgical operations on patients in order to save lives. Also, pharmaceutical industries employ accurate measurement skills in manufacturing drugs and other chemicals. Accurate measurement helps civil engineers to make sure that, roads, buildings, and other construction works are correctly done in order to minimize avoidable accidents, ensure quality work and value for money. Mechanical engineers, who design, make and fix machines, make good use of their measurement skills. Farmers and agriculture extension workers need the skills of accurate measurement of quantities such as length, volume and area so that they can measure their farm land and apply the correct amount of inputs such as fertilizer, pesticide, and weedicide to improve yield. Also, farmers and vertenary officers need to acquire basic vertenary services to treat their farm animals and this involves acquisition of basic skills in measurement of volume of chemicals. Carpenters also employ the skills of accurate measurements of length and area in their work such as roofing, making of chairs, tables, doors and windows among others. Also, traders use measurement of mass and length in selling their goods such as foodstuffs and clothing to avoid cheating or incurring loss. Dress-makers use their measurement skills in taken the dimensions of their clients in order to design and make clothing that properly fit them (the clients). Sports men and women need the skills of calculating time, length, speed and area in performing their work in order to meet their targets. To this end, the importance of measurement of quantities cannot be over- emphasized in various aspects of our daily live.

Unfortunately, we sometimes hear, see, experience or witness cases that show that some people do not employ accurate measurement skills of quantities in their work . it was observed that a tailor took the measurement of a client but the clothes could not fit the client. The researcher also witnessed cases whereby some farmers have their crops destroyed by using overdose of chemicals in spraying their farms as a result of lack of measurement skills in mixing the chemicals with water. Another case in point is the collapse of 'MELKOM' shopping mall in Achimota, Accra, Ghana, on 7th November, 2012. That incident and other similar cases across the country claimed many lives as a result of using inaccurate amount of construction materials such as cement partly due to lack of accurate measurement skills. Also, there are cases where some people take overdose of medicine simply because they cannot follow the instructions given them by health workers in measuring the medicine in milliliters or in milligrams due to lack of measurement skills.

Measurement of quantities poses problems to many students, including those of Savelugu Municipal Assembly Junior High School in the Savelugu-Nanton municipality in the northern region of Ghana.

1.2 Statement of the Problem

There has been learning difficulties among form-three students in Savelugu Municipal Assemble Jonior High School 'B' certain concepts and skills of measurement of some physical quantities. Their main learning difficulty is measurement of quantities such as length, temperature, mass, weight, area and volume. This development adversely affects their academic performance especially in integrated science. There is therefore the need to give special attention to the students so that they could understand the concepts and acquire the skills in measuring quantities (length, temperature, weight, mass, and volume). The study, therefore, intends going beyond the normal classroom work to giving them extra time and series of practical activities in measuring quantities.

1.3 Purpose of the Study

The purpose of this study is to identify the causes of the inability of form-three students of Savelugu Municipal Assembly Junior High School 'B' to understand the concepts and acquire the skills in measuring quantities in integrated science.

1.4 Research Objectives

1.4.1 General Research Objective

After going through the study, the participants will be able to improve upon their performance in understanding the concepts and measurement of some physical quantities in integrated science.

1.4.2 Specific Research Objectives

The study is intended to address the following:

i) To identify the causes of participants' inability to explain the meaning of the concepts of measurement of some physical quantities.

ii) To identify the causes of participants' inability to acquire the requisite skills in measuring physical quantities.

iii) To find out whether the students would be able to measure the physical quantities after an intervention.

1.5 Research Questions

i) What could be responsible for the inability of the students to explain the meaning of measurement of quantities in integrated science?

ii) Why is it difficult for them to acquire the requisite skills in measuring physical quantities?

iii) Can the students measure the physical quantities as a result of the intervention?

1.6 Significance of the Study

The importance of this study cannot be over- emphasized. The study can, in the first place, help students of Savelugu Municipal Assemble Junior High School to improve their performance in measurement of quantities in integrated science in particular, and their academic career, at large. Also, teachers in Savelugu Municipal Assembly Junior High School and other interested teachers in other schools can use it to sharpen their lesson delivery strategies. Furthermore, students in other schools within the municipality may benefit from the recommendations of the study as their teachers may adopt it in teaching them.

1.7 Limitations

There were some challenges encountered during the study. For instance, two of the respondents were not cooperating. Furthermore, there were inadequate logistics (measuring instruments) for the group work he engaged participants in. Also, financial constraint and tight workload hampered the smooth administration of the interventions. In addition, some of the participants' weaknesses in arithmetic affected their ability to do accurate measurement that required calculation. That posed extra burden on the researcher such that he had to take them through some calculations. Finally, it is observed that action research of this sort is difficult to be single-handedly carried out by one person.

1.8 Delimitation

The study was limited to only form- three students of Savelugu Municipal Assembly Junior High School. It focused on measurement of quantities in integrated science using activity-oriented method. For measurement of mass, measuring instruments such as beam balance, and direct reading balance was used but the chemical balance and the lever balance was not used in the practical activities due to difficulty in acquiring them. Also, metre rule and measuring tape was used in the measurement of length. Vernier calliper and micrometer screw gauges were not used as a result of limited time frame for the study since using them requires much time for practice. In addition, only the digital thermometer was used in the practical activities in the measurement of human body temperature since darkness in the classroom affected the use of the liquid-in-glass thermometer. Temperature was measured in degree Celsius only but not in Fahrenheit (F) nor Kelvin (K) because it is the degree Celsius that is often used in Ghana. Only the spring balance was used in the measurement of weight since the dial spring balance could not be procured in the study. Measurement of surface area was limited to rectangular shapes. Volume measurement included regular and irregular solid shapes as well as liquid substances. Measuring cylinders, beaker and displacement cans were used in the measurement of volume of liquid substances.

1.9 Organization of the Study

The research report is organized into five chapters. Chapter one deals with introduction which contains background to the study, statement of the problem, purpose of the study, research questions, research objectives, significance of the study, delimitation, and limitations. Chapter two focuses on review of literature and chapter three contains methodology. Chapter four involves presentation and discussion of research findings/results. Finally, chapter five contains summary, conclusion and recommendations.

1.10 Conclusion

This chapter examined the significant role that measurement of physical quantities plays across the sphere of life be it in educational institutions, industrial set up, engineering, and health care providers among others.

CHAPTER TWO

LITERATURE REVIEW

2.0 Introduction

This chapter dealt with the literature review on the concept of measurement and brief history of measurement. The review also included the concepts and measurements of physical quantities such as length, mass, weight, temperature, volume and area. In addition, the basic tenets of the activity-oriented and the demonstration methods were reviewed.

2.1 The Concept of Measurement

The concept of measurement of physical quantities has been examined by several schools of thought. Measurement of quantities is making comparison of unknown quantity with fixed quantity of the same kind (Quarm, 2013). Volume seven of the 15th edition of Encyclopedia Britannica describes measurement as the process of associating numbers with physical quantities and phenomena. "Measurement is the process of determining the quantity of a substance" (Obeng, 2012: 20). There are reasons why we should measure accurately and these include the following: to prevent wastage; to avoid cheating; to prevent over dose and under dose in preparation and dispensing medicine; to avoid compromising with quality and standards; to maintain honesty and integrity; to show truthfulness; and to show consistency and reliability (Obeng, 2012).

Measurement could also be explained as the process of obtaining the magnitude of a quantity relative to an agreed standard. Every measurement provides three kinds of information: the size or magnitude of the measurement (a number); a standard of comparison for the measurement (a unit); and an indication of the uncertainty of the measurement. While the number and unit are explicitly represented when a quantity is written, the uncertainty is an aspect of the measurement result that is more implicitly represented. The number in the measurement can be represented in different ways, including decimal form and scientific notation. Scientific notation is also known as exponential notation. For example, 298,000 kilograms can also be written as 2.98×10^{5}kg, while 0.0000025 kilograms can also be written as 2.5×10^{-6} kg (Quarm, 2013).

A quantity is the aspect of matter that is measured. In other words, it is the description of matter that is measured. Quantities that can be measured are referred to as physical quantities. Examples of quantities that can be measured include length, area, mass, volume, weight, and temperature among others. Units are used to express the values of quantities measured. Units are therefore considered as the standards of measurement. Examples of units are metre (m), kilogrm (k), cubic metre, etc (Obeng, 2012).

2.1.2 Brief History of Measurement

Useful as it is in our daily activities, measurement has an interesting history. “Measurement was among one of the first intellectual achievements of early humans. People learned to measure centuries before they learned how to write and it was through measurement that people learned to count. People of the Peking and Neanderthal periods had implements constructed from materials individually determined to be the right length or weight for a particular purpose” (Katz, 2008: 1).

Katz (2004) noted that any tool that worked well became the model and standard for another and they used their fingers, hands, arms, legs, etc. to measure length. “Measurement of weights was based on use of certain containers or what a person or beast could haul. Each unit was separate and unrelated since their ability to count was not developed. Since humans have ten fingers, we learned to count by tens, and ways were soon found to relate units to each other" (Katz, 2008: 1).

Some of the most well-known early units of measurement were:

- Inch - the width of the thumb.
- Digit - the width of the middle finger (about 3/4 inch)
- Palm - the width of four fingers (about 3 inches)
- Span - the distance covered by the spread hand (about 9 inches)
- Foot - the length of the foot. It was later expressed as the length of 36 -barleycorns taken from the middle of the ear (about 12 inches).
- Cubit - distance from the elbow to the tip of the middle finger (about 18 inches).
- Yard - distance from the center of the body to the fingertips of the outstretched arm (about 36 inches).
- Fathom - distance spanned by the outstretched arms - about 72 inches (Katz, 2008).

"Of course, these units varied from person to person, creating many difficulties. When individuals worked together, the leader would use his body as the sole authority. Measurements would be matched to samples made by him. As measurement and tools became more sophisticated, measuring sticks were made" (Katz, 2008:2).

Katz (2008) noted that the Egyptians had a strong system of measurement including the royal cubit which was 524 millimeters (20.62 inches) in the Great Pyramid at Giza. Also, the Greeks and the Romans had strong systems of measurements, but these disintegrated with the empires.

“Through the medieval period, people used measurements which became accepted in particular trades, but no standards existed. Generally, measurements standards for a region would be embedded in the wall of the city hall or in the central square of a town. Finally, in an effort to introduce a standard into the measuring system, in the eleventh century, King Henry I, of England, defined the standard yard from the tip of his nose to the end of his thumb on his outstretched arm” (Katz, 2008: 3). King Henry VII, in 1490, adopted an octagonal yard bar which was distributed as the national standard measure. Even though it was changed about 100 years later, by Elizabeth I, the idea of a standard yard remained (Katz, 2008).

“A parliamentary Committee undertook the job of clearing away the medieval weights and measures, setting up a standard system of weights and measures in 1824. The Americans, who were already accustomed to the English system of weights and measures set up their system which became standardized in the mid 1900’s” (Katz, 2008: 4). The standardization of weight and measures were done by several countries. While the British and the Americans were trying to standardize their weights and measures, France deduce an invariable standard for all of the measures and all weights and adopted the metric system in 1795 (Katz, 2008).

“The metric system, which was adopted by France in 1795, existed along with the use of the old medieval units until 1840 when it was proclaimed as the exclusive system of weights and measures. In 1875, the metric system was universally accepted at the International Metric Convention in France and provisions were made to set up an International Bureau of Weights and Measures in Paris” (Katz, 2008: 4).

In due course, the definitions of the original metric standards were redefined to 20th-century standards of measurement and a new International System of Units was formulated. The International System of Units, as amended in 1971, consists of seven base units as listed in table 1 (Katz, 2008).

Table 2. 1: SI Base

Quantity	Measured Unit	Symbol
Length	Meter	m
Mass	kilogram	kg
Time	second	s
Thermodynamic	temperature	k
Amount of substance	mole	mol
Electric current	ampere	A
Luminous intensity	candela	Cd

Source: Katz, 2008.

Table 2.2: Other SI-Derived Units

Physical Quantity	**SI Unit**	**Symbol**
Area	square meter	m^2
Volume	cubic meter	m^3
Density	kilogram per cubic meter	kg /m^{-3}
Pressure	pascal	Pa or N/ m^2
Velocity	metre per second	m/s
Power	watt	W
Work and Energy	joule	J
Force	newton	N
Electric resistant	ohm	Ω
Electric potential	volt	V
Quantity of electricity	coulomb	C

Source: Katz, 2008.

Table 3 shows some Non-SI units used in chemistry with conversion factors to SI

Table 2.3: Non-SI units used in chemistry with conversion factors to SI

Physical Quantity	SI Unit	Non-SI	Unit Symbol	Conversion Factor
Length	meter	Angstrom	Å	1 Å = 10^{-10} m
Mass	kilogram	tone	t	1 t = 10^{3} kg
Temperature	Kelvin	Celsius	°C	1 °C = 1 K
Volume	cubic meter	liter	L	1 L = 1 dm^{3}
Time	second	minute	min	1 min = 60 s

Source: Katz, 2008.

Some conversion factors which will be extremely useful, especially in laboratory work include the following:

1 cm^{3} = 1 mL.

1 mL H_2O = 1 g H_2O

Length: 1 in = 2.54 cm

Volume: 1.057 qt = 1 L

Mass: 1 lb = 453.6 g.

39.37 inch = 1 m

1 mile = 1.609 km

2.2 lb = 1 kg (Katz, 2008).

The definitions of the five base units that are useful in general chemistry are:

"The metre(m). The metre was originally measured to be one ten-millionth of the distance from the North Pole to the equator along the meridian running near Dunkirk, Paris, and Barcelona. It was redefined in 1971 as the length of path traveled by light in a vacuum during the time interval of 1/299 792 458 second" (Katz, 2008: 5)

"The kilogram(kg). The Kilogram is the mass of a particular cylinder of platinum-iridium alloy, called the International Prototype Kilogram, kept at the International Bureau of Weights and Measures in Serves, France. The kilogram, the only unit still defined by an artifact, was derived from the mass of a cubic decimeter of water" (Katz, 2008: 4).

"The second(s). It was originally defined as 1/86,400th of a mean solar day. It was redefined in 1967 as the duration of 9,192,631,770 periods of the radiation corresponding to the transition between two hyperfine levels of the fundamental state of a cesium-133 atom" (Katz, 2008: 4).

"The Kelvin (K). The Kelvin is 1/273.16 of the temperature interval between absolute zero and the triple point of water (the temperature at which ice, liquid water, and water vapor are in equilibrium). The -Celsius scale is derived from the -Kelvin scale. An interval of 1 K is equal to 1°C" (Katz, 2008: 4).

"The mole (mol). It is the amount of substance which contains as many entities as there are atoms in exactly 0.012 kg of carbon-12" (Katz, 2008: 4).

2.2 The Concept of Temperature

The temperature of a body is defined as the degree of hotness or coldness of the body' (Asiedu, 2012: 45). 'Temperature is the measure of how cold or hot a body is' (Twumasi, 2012: 23). Quarm (2013) defined temperature as the hotness or coldness of a body on a chosen scale. The SI unit of temperature is the Kelvin (K). The Kelvin is defined as the 1/273.16 of the thermodynamic temperature of the triple points of water, the temperature at which the solid, liquid, and vapour phases of water exist in equilibrium. "Temperature and heat are not the same phenomenon. Temperature is the measure of the intensity or degree of hotness in a body. Technically, it is determined by getting the average speed of a body's molecules. Heat is a measure of the quantity of heat energy present in a body. Heat always flows from warmer to colder areas" (Pidwirny, 2006:1).

2.2.1 A Brief History of Temperature Measurement

Temperature measurement is an age-old activity among the ancient people. "Ancient people were physically aware of hot and cold and probably related temperature by the size of the fire needed, and how close to sit, to keep warm" (Katz, 2008: 2).

Katz (2008) noted that an Australian tribe, being primitive at the time, used dogs instead of blankets to keep warm, thus, they could relate temperature by the dog. A moderately cool night that required two dogs to keep warm was called "a two-dog night" and that of an icy night that required six dogs to keep warm was known as "a six-dog night".

Early people learned to work with fire to gain the heat needed to boil water, cook meat, fire pottery work with copper, tin, bronze and iron, and to make glass. Although they had no quantitative measuring devices to determine how hot a fire was, they developed recipes for building different types of fires and probably used a physical indicator, such as some mineral or metal melting, to indicate the correct temperature for a particular process. Even though the ancient Greeks knew that air expanded when heated and applied the principle mechanically, they developed no means of measuring temperature or amount of heat needed and devised no measuring instruments (Katz, 2008).

2.2.2 Invention and Development of the Thermometer

Thermometer is the instrument that is used to measure temperature of a body. The first recorded thermometer was produced by the Italian, Santorio Santorio (1561-1636) who was one of a group of Venetian scientists working at the end of the Sixteenth Century. As with many inventions the thermometer came about through the work of many scientists and was improved upon by many others. “The Italian scientist Galileo (1564-1642) is one of the first recorded to attempt to measure temperature in 1592. His measuring device consisted of a bulb of air, which, when heated, forced liquid down a column immersed in an open container of the liquid. In about 1611, the thermometer was calibrated by Sanctorius Sanctorius, a colleague of Galileo, who noted the liquid level when the bulb was cooled with melting snow and again, when heated with a candle” (Katz, 2008: 3).

In 1632, Jean Rey (1582-6145), a French physician, invented the first liquid thermometer which consisted of a flask with a long slender neck partially filled with water. As the temperature changed, the liquid level would rise or fall in response. Unfortunately, it was later realized that these early thermometers were affected by changes in atmospheric pressure (Katz, 2008).

In due course, the attention was given to attaining a reproducible temperature scale. The thermometer was calibrated at two temperatures, providing fixed marks, and dividing the interval between them. One such scale was a 12 degree scale devised by Sir Isaac Newton (1642-1727) where melting ice was assigned as zero degrees and body temperature as 12 degrees. One of the better scales was that of Ole Romer (1644-1710), a Danish astronomer, who used an ice-salt mixture, which he assigned as zero degrees, and boiling water which he assigned as 60 degrees. This made the freezing point of water 8 (degrees) on his scale and body temperature was 22½ (degrees).

Romer's scale is important since it influenced Daniel Gabriel Fahrenheit (1686-1736), a Dutch instrument maker of German descent. Fahrenheit had gained famed for his high quality mercury thermometers and the agreement between them when calibrated using his temperature scale. Fahrenheit used zero for the ice-salt mixture, 32 for the freezing point of water, and 96 for body temperature (Katz, 2008 & Berlis, 2017).

"Fahrenheit discovered that body temperature varied over the course of a day and searched for a better fixed point for his upper temperature. He finally determined the boiling point of water to be 212 degrees on his scale. Body temperature was later adjusted to approximately 98 degrees. The modern Fahrenheit scale uses the boiling point and freezing point of water as its two fixed points" (Katz, 2008: 5).

The Celsius scale is attributed to the Swedish astronomer Anders Celsius (17011744). In 1742, Celsius set up his thermometer scale by assigning 0° to the boiling point of water at a specific barometric pressure, and 100° to the temperature of melting snow. Shortly, thereafter the inverted form of Celsius' scale i.e., 0° for the freezing point and 100° for the boiling point of water, came into use in Sweden and France known as the Centigrade scale which was officially named the Celsius scale in 1948 (Katz, 2008 & Berlis, 2017).

"The Absolute temperature scale was based on calculations from the gas law of Jacques Charles' and Joseph Gay-Lussac which showed that the volume of a gas decreases by 1/273.15 its volume at 0°C and one atmosphere pressure for each one degree drop in temperature. This law gave rise to the temperature, absolute zero, which was defined to be the temperature at which an ideal gas would have no volume and which was determined to be -273.15°C" (Katz, 2008: 5).

Katz (2008) and Berlis (2017) indicated that Lord Kelvin (1824-1927), in 1848, proposed a thermodynamic temperature scaled based on the efficiency of an ideal heat engine proposed in 1824 by Sadi Carnot. He added that Kelvin showed that the temperatures defined through his calculations were identical with those defined by the gas laws and that to keep his scale compatible with those already in use he set the size of the temperature degrees equal to those of the Celsius scale. Thus, the Kelvin has the same magnitude as the degree Celsius.

2.2.3 Temperature Conversions

Katz (2008) indicated that modern chemistry works in the Celsius and Kelvin scales. Therefore conversion from Celsius to Kelvin is crucial and requires simple addition since the degrees are the same. The formula is: K = °C + 273, where K refers to the Kelvin scale and C is the Celsius scale.

2.2.4 Human Body Temperature

Measurement of human body temperature is a prerequisite in the process of health delivery. Lim et al (2008) indicated that normal human body temperature is a concept that depends upon the place in the body at which the measurement is made, and the time of day and level of activity of the person. They added that there is no single number that represents a normal or healthy temperature for all people under all circumstances using anyplace of measurement and that different parts of the body have different temperatures, and the commonly accepted average core body temperature is 37.0 °C (98.6 °F).

"The time of day and other circumstances also affects the body's temperature. The core body temperature of an individual tends to have the lowest value in the second half of the sleep cycle; the lowest point, called the nadir, is one of the primary markers for circadian rhythms. The body temperature also changes when a person is hungry, sleepy, or cold" (Lim, et al, 2008: 5). Temperature control (thermoregulation) is part of a homeostatic mechanism that keeps the organism at optimum operating temperature, as it affects the rate of chemical reactions. Temperature level in an organism is not static; it rises and falls depending on several factors. The lowest temperature occurs about two hours before the person normally wakes up. Additionally, temperatures change according to activities and external factors. Normal body temperature may differ as much as 0.5 °C (1.0 °F) from day to day. In addition, body temperature is sensitive to many hormones, so women have a temperature rhythm that varies with the menstrual cycle. A woman's basal body temperature rises sharply after ovulation, as estrogen production decreases and progesterone increases. Temperature also varies with the change of seasons during each year. Increased physical fitness increases the amount of daily variation in temperature. With increased age, both average body temperature and the amount of daily variability in the body temperature tend to decrease (Katz, 2008).

"Exercise raises body temperatures. In adults, a noticeable increase usually requires strenuous exercise or exercise sustained over a significant time. Children develop higher temperatures with milder activities, like playing. Psychological factors also influence body temperature: a very excited person often has an elevated temperature" (Katz, 2008: 5).

Sleep disturbances also affect temperatures. Normally, body temperature drops significantly at a person's normal bedtime and throughout the night. Short-term sleep deprivation produces a higher temperature at night than normal, but long-term sleep deprivation appears to reduce temperatures. Insomnia and poor sleep quality are associated with drops in body temperature (Lim, et al, 2008).

2.2.5 Measurement of Human Body Temperature using the Digital and the Liquid-in-glass Thermometers

A thermometer is an instrument used to measure the temperature of a body.

Using digital thermometer:- The thermometer is cleaned and then put under the armpit of the person whose temperature is to be determined for some few minutes (3-5) within which the temperature of the person is displayed on the screen of the thermometer and then it is recorded

Using the liquid- in- glass thermometer (clinical thermometer):- The thermometer is cleaned and reset to a point below 35 degrees Celsius and then placed under the armpit of the body whose temperature is to be determined. After 3-5 minutes the liquid Mercury/alcohol in the glass tube rises to the maximum level of the body's temperature. The corresponding calibrated value on the thermometer is read as the temperature of the body (Quarm, 2013).

2.3 The Concept of Length

Length refers to the distance between two points (Asiedu, 2012). 'Length is the distance between two fixed points' (Tsumasi, 2012: 36). Obeng (2012) defined length as the quantity that describes distance; how long or short an object or a thing is.

2.3.1 Measurement of Length Using Metre Rule and Surveyors Tape

Using the meter rule:- Very short straight edges and distances are measured using the metre rule. The metre rule is placed against the object to be measured. The zero mark on the metre rule is made to coincide with one end of the object to be measured. The required length of the object is the mark on the metre rule that coincides with the other end of the object (Asiedu, 20112).

Using the surveyors tape:- Relatively longer distances such as the length of a football park among others are measured using the surveyors tape. The steps involve in using the surveyors tape are same as that of the metre rule (Asiedu, 2012).

2.4 The Concept of Mass

The mass of a particular substance is a measure of quantity of matter (material) contained in the substance' (Asiedu, 2012: 37). Twumasi (2012) defined mass as the quantity of material in a substance or the quantity of matter in a substance. Obeng (2012) defined the mass of a body as .the quantity of matter contained in the body. The SI unit of mass is the kilogram (kg) but it can also be measured in smaller units such as grams (g) and milligrams (Quarm, 2013).

"Mass is a quantitative measure of inertia of a body at rest. As a physical quantity, mass is the product of density and volume" (Fritz & Emil 1999: 1).

Mass is the property which reflects the quantity of matter within a sample. Mass usually is reported in grams and kilograms. Mass may also be considered to be the property of matter that gives it a tendency to resist acceleration. The more mass an object has the harder it is to accelerate it. Mass is a dimensionless quantity, representing the amount of matter of a substance. The standard (SI) unit of mass is the kilogram. The Kilogram is defined as the mass of a particular platinum-Iridium bar which is maintained under much specified conditions at the International Bureau of Weights and Measured.

Mass is an intrinsic property of a body and remains same wherever the body might be. Mass and weight behave as twins as far as their measurement is concerned. In this light, the common way of measuring the mass of an object is to compare its weight with the weight of a standard or known object on a scale. Some standard conversions of mass include the following: 1000g = 1kg; 1000000mg = 1000g = 1kg; 1/1000kg = 1g (Fritz, 1999).

Mass is measured by determining the extent to which a particle or object resist a change in its direction or speed when a force is applied (Rose, 2017).

2.4.1 Measurement of Mass

Measuring instruments for mass include beam balance, chemical balance, lever balance, direct reading balance and electronic balance. The electronic balance and the direct reading balance are devices that are commonly used in measuring mass.

Using the electronic balance:- The mass of the cleaned empty container in which the substance is put is weighed and recorded as M_1. The object whose mass is to be determined is placed on the empty container and put on the measuring device. Some time is allowed for the scale reading to be displayed and then recorded as M_2. The mass of the substance is determined as $M_2 - M_1$ (Fritz, 1999).

Using the Direct reading balance:- The object is put on the pan of the balance and the pointer reading is recorded as the mass of the object (Obeng, 2012). Kurtus (2016) noted that the common way to measure the mass of an object is to compare its weight with the weight of a standard or known object on a scale. He added that the standard unit of mass was originally defined in 1795 as the mass of one cubic centimeter of water at the melting point of water at 4°C, and since a gram was too small to be used commercially, the standard was increased 1000 times to be the kilogram.

"Also, to avoid problems with using water, a solid prototype kilogram made of such materials as a platinum-iridium alloy is now used. Prototypes are kept in standard labs. Although mass and weight are not the same, they are related by the equation: $W = mg$. Where W is the weight of the object, m is its mass and g is the acceleration due to gravity. This means that the ratio of masses of two objects equals the ratio of their weights: $^{W1}/_{W2} = {^{m1}/_{m2}}$ " (Kurtus, 2016: 1).

"Thus, the mass of an object is usually determined by comparing its weight with a standard weight on a scale. You can make adjustments to the Standard Weights, or the position of the fulcrum to balance the scale and determine the mass of the object" (Kurtus, 2016: 1). Using simple lever to measure mass; the equation to find the mass of the Weight to be measured is: $m = {^{MdE}/_{dL}}$. Where m is the mass of the Weight to be Measured, M is the mass of the Standard Weights d_E is the distance to the fulcrum from the Standard Weights, d_L is the distance to the fulcrum from the Weight to be Measured. By adding or subtracting weights to

M or by moving the fulcrum, you balance the weights and determine the value for m (Kurtus, 2016).

"According to *Newton's Law of Inertia*, objects require a force applied to them to change their motion. The equation for that is $F = ma$. Where F is the force applied, m is the mass of the object, a is its acceleration. What this means is that if we know the amount of force pushing on an object, and we measure its acceleration or how fast it is changing its velocity, we can then calculate the mass of the object. All matter has the property of possessing a gravitational field" (Kurtus, 2016: 2). Newton's *Universal Law of Gravitation* states that the force of attraction between two objects is according to the equation $F = GMm/r^2$. Where F is the force of attraction between the two objects, G is the universal gravitational constant = 6.67×10^{-11} N-m^2/kg^2, M is the known mass, m is the unknown mass, r^2 is the square of the distance between the centres of the two objects. Thus, if you can measure the force between the two objects, know the mass of one, and know the distance between them, you can measure the mass of the other object. However, the challenge is that the objects must be very large for the force to be measurable (Kurtus, 2016, & Rose, 2017).

2.5 The Concept of Weight

Twumasi (2012) noted that the weight of an object is the measure of the force of gravity acting on that object or the force a body possesses due to the force of gravity acting on it. 'The force with which the earth attracts a body towards its center is the weight of the body' (Quarm, 2013: 535). 'The weight of an object is a measure of the force of gravity on that object or the weight of a body is the force the body exerts on anything that freely supports it' (Asiedu, 2012 :39). Weight is the force with which a body is attracted toward the Earth (Fritz & Emil, 1999).

Weight is a force, and force is a vector quantity having both direction and magnitude associated with it. Weight is force, and force is mass × acceleration due to gravity (i.e. $W = m \times g$). Weight is a measure of how strongly gravity pulls on a body. The SI unit of weight is Newton (Fritz & Emil, 1999).The following is a list of the weights of a mass on the surface of some of the bodies in the solar system, relative to its weight on Earth:

- Weight on Mercury = 0.378
- Weight on Venus = 0.907
- Weight on Earth =1
- Weight on Moon =0.165
- Weight on Mars = 0.377
- Weight on Jupiter = 2.364
- Weight on Saturn = 0.910
- Weight on Uranus = 0.889
- Weight on Neptune = 1.125 (Kurtus, 2016).

2.5.1 Measurement of Weight Using Spring Balance and Dial Spring Balance

The spring balance is hanged freely on the ring. The object whose weight is to be determined is hanged from the hook of the spring balance and the object is allowed to be still (i.e. without swinging). The pointer position on the scale of the spring balance now indicates the weight of the load (Asiedu, 2012).

2.6 The Concept of Area

Asiedu (2012) noted that the area covered by the surface of a regular object is the two dimensional space the object occupies. Area, as many mathematical concepts, has experiential origins. It is the measure of expanse associated with plain figures. Area is a 2-dimensional analogue of the1-dimensional length and 3-dimentional volume (Alexander, 2016). 'Area is the space covered by a flat or plane surface' (Twumasi, 2012: 26).

2.6.1 Measurement of Area

The area of regular objects can be measured by the application of useful formulae as indicated below. The area of a rectangle is the base × the height $(b\times h)$ whiles that of a triangle is half the product of the base and the altitude, $^{1}/_{2}(b\times h)$. The area of a square is $a \times a = a^2$; where *a* is the length of the square. The area of a circle is *pie* times the square radius of the circle (πr^2) and that of a sphere is four times *pie* times *square* radius ie, $4\times\pi\times r^2$ (Asiedu, 2012).

2.7 The Concept of Volume

Asiedu (2012) defined volume as a three-dimensional space occupied by matter or the amount of space occupied by matter. 'Volume is the amount of space occupied by a body' (Quarm, 2013: 531). The volume of an object or substance is the amount of space occupied by the object or substance. The SI unit of volume is the cubic metre (m^3) but cubic centimetre (cm^3), which is much smaller, is used in elementary science. The litre and millilitre are commonly used units for measuring the volume of liquids. Below are some examples of standard conversions. 1litre = 1,000millilitres; 1m^3 = 1,000litres; 1m^3 =1,000,000ml = 1,000,000cm^3 (Obeng, 2012).

2.7.1 Measurement of Volume

Solid regular shapes:- The volume of regular shapes of solid objects such as a wooden/metal block is determined from their physical dimensions. The dimensions are measured using a metre rule and the appropriate readings (values) are recorded. The values are used in the appropriate formulae to calculate the volume. Examples,

- The volume of a rectangular block = *length* × *breadth* × *height*.
- The volume of a cylinder = *pie* × *square radius* × *height*.
- The volume of a cone = $^1/_3$ (*pie* × *radius square* × *height*) (Asiedu, 2012).

Solid irregular shaped objects that sink in water:- The volume of these irregular solids can be determined by complete immersion in water in a displacement can or in a measuring cylinder. The principle is that the solid will displace a volume of water which is equal to the volume of the solid. The following steps are taken into consideration.

Steps:

- A measuring cylinder is filled with water to a suitable level,
- The initial volume is recorded as V1,
- A suitable length of tread is tied to the solid object,
- The object is gently lowered into the water inside the measuring cylinder; the level of the water goes up,
- The new volume is recorded as V_2,
- The initial volume (V_1) is subtracted from the final volume (V_2) to get the volume of the irregular object (Asiedu, 2012).

Solid irregular shaped objects that float:- The object is nailed and the whole object is pushed into the water in the displacement can by holding the nail. The object displaces a volume of water into the measuring cylinder provided. The volume of the water displaced is read from the graduation of the measuring cylinder and then recorded. The volume of the water displaced into the measuring cylinder is equal to the volume of the object (Asiedu, 2012).

Measuring Volume of liquid using the measuring cylinder:- When the volume of a liquid is to be determined, the liquid is delivered into the measuring cylinder using a pipette or burette and the volume is read at the meniscus. Reading is taken at eyed-level, horizontal plane at 90 degrees to the meniscus (Tsumasi, 2012).

2.8 Activity-oriented Teaching Method

Raj (2015) describes activity- oriented method of teaching as a pedagogical approach to teaching which focuses or based on doing some hands-on experiments and activities. He added that it is a general teaching method (e.g., problem solving, design challenge, field trips, role-playing) based on planned, purposeful involvement of students.

It is a technique adopted by a teacher to emphasize his or her method of teaching through activities in which the students participate rigorously and bring about efficient learning experiences. It is a child-centered approach where the child is actively involved in participating mentally and physically. Learning by doing is the main focus in this method. Learning by doing is imperative in successful learning since it is well proved that the more the senses are stimulated, the more a person learns and the longer the retention (Raj, 2015).

Activity-based learning as a method is where children of different age groups are grouped together in a classroom and each of them learns at his/her own pace through a series of activities. Activity-based teaching is a constructivist teaching approach which involves hands-on, creative, participative method of teaching. Types of activity-based learning include ***exploratory***: where children gather knowledge and skills; ***Constructive***: where children get experience through creative work; ***expressional***: where children do presentations. The role of teacher can play in activity-oriented learning is to be a *planner*; *organiser*; *evaluater*; *facilitator*; *discussion maker*; *knowledge imparter*; and *disciplinarian*. The following are some of the roles that students should play in activity-based learning. *Taking active part in the activities; interacting and collaborating with others; discussing and researching for ideas; being confident and well-prepared* (Danneca, 2014).

2.8.1 Strengths of the Activity-oriented Learning Method

The information processing theory in psychology views learners as active investigators of their environment. This theory is grounded in the premise that people innately strive to make sense of the world around them. In the process of learning, they experience, memorize and understand. Students need to be provided with data and materials necessary to focus their thinking and interaction in the lesson for the process of analyzing the information. Teachers need to be actively involved in directing and guiding the students' analysis of the information (Limbu, 2012). Limbu (2012) noted that activity-oriented teaching method requires active problem solving by students in finding patterns in the information through their own investigation and analysis, and with continued practice in these processes, students learn not the content of the lesson but also develop many other skills.

Activity-oriented teaching method enhances creative aspect of experience. In addition, it gives reality for learning, uses all available resources, provides varied experiences to the students to facilitate the acquisition of knowledge, experience, skills and values; and builds the student's self-confidence and develops understanding through work in his/her group. The child also gets experiences, develops interest, enriches vocabulary and provides stimulus for reading. Further more, the method develops happy relationship between students, and teachers and students. An activity is said to be the language of the child. A child who lacks in verbal expression can make up through use of ideas in the activity. Subjects of all kind can be taught through activity. Social relation provides opportunity to mix with others (Limbu, 2012).

Learning occurs through activities; learning becomes fun and enjoyable process if executed well; learning is contextual and concrete so easy to grasp; classroom activities are learner centred; retention of knowledge/skills is permanent; it affords students opportunity to take active part in learning; and students are self-motivated (Prativa, 2016).Ramesh (2011) outlined strengths of activity-based learning method which include the fact that it fulfills the urge of a natural growing child, promotes better understanding of a lesson among students as they practice the tasks themselves, inspires students to apply their creative ideas in solving problems, and it helps students psychologically as they can express their emotions through active participation in something useful.

2.8.2 Weaknesses of the Activity-oriented Learning Method

Very specialised teacher training is required for applying this methodology; It is expensive as it require large number of material aids; It is time consuming and completing the syllabi with in stipulated time period can be a challenge; Much advanced technique of learning, if not implemented properly can inhibit learning; Complete waste of time and money if not applied appropriately. It requires lengthy procedure for planning and executing, hence, time consuming; it is less useful for social sciences (Ramesh, 2014).

2.8.3 Steps Required for Organizing Activities in Teaching/Learning Process

- Planning
- Involving students in the learning process
- Each child should be made an active learner
- For each activity ensure that the following principles are followed: what concepts/skills to teach; how to teach it (step by step); how long the lesson will last etc.
- Ensure clear instructions are given before each activity.

2.9 The Concept of Demonstration as a Method of Teaching

Demonstration refers to the process of performing an activity so that learners can observe how it is done in order to help prepare learner to transfer theory to practical application. A demonstration is any planned performance by a presenter of an occupational skill, scientific principle or experiment. The demonstration method is best used in teaching learners how to perform manipulative operations. Demonstration method is a teaching method that relies heavily upon showing the learner a model performance that he/she should match or pass after he has seen a presentation that is live, filmed, or electrically operated (Sonam, 2012).

2.9.1 Strengths of the Demonstration Method of Teaching

The method of demonstration model helps to model others. It promotes self-confidence, opportunity for targeted questions and answers, allows attention to be focused on specific details rather than general theories, and saves time in its presentation. In addition, learners concentrate on relationships to be understood, makes efficient use of the power of observation. It is also a means of strong motivation, and can be used in training groups or individuals. Furthermore, it involves both senses (sight and touch) which play vital role in learning process; it helps to achieve psychomotor objectives; it makes complex tasks/skills simple to students (Umar, 2013).

2.9.2 Weaknesses of the Demonstration Method of Teaching

Demonstration can be of limited value for people who do not learn best by observing others; it may not be appropriate for the different learning rates of the participants; it requires that demonstrator should have specialized expertise if highly technical tasks are involved. Furthermore, demonstration method can be used only for skills subject. Also, acquiring demonstration tools/equipment is sometimes not easy, and it requires that the teacher should be an expert in that field otherwise a resource person should be invited (Umar, 2013).

2.9.3 Key Points to Note in Carrying out Demonstration Method

The person should:

- Be able to do well what you want to demonstrate,
- Carefully plan the demonstration,
- Safety precautions involved in the demonstration should be discussed,

- Keep the demonstration simple and the explanation thorough enough to meet your objectives,
- Be patient with trainees,
- Ask oral questions,
- Use the appropriate learning aids,
- Augment the demonstration with other visual aids,
- Summarise the lesson by repeating the steps in the demonstration,
- Give learners an opportunity to practice what has been demonstrated (Umar, 2013).

2.10 Conclusion

The chapter dealt with literature review on the works of several authors on the concepts and measurement of some physical quantities, activity-oriented teaching method, and demonstration teaching method.

CHAPTER THREE

METHODOLOGY

3.0 Introduction

The methodology describes the rationale for the application of specific procedure used to identify, select, and analyse data applied to understanding the research problem, thereby, allowing the reader to evaluate the study's overall validity and reliability. This chapter consists of the design used in the study and the setting in which the study was conducted. It also dealt with population, sample size, and sampling techniques. In addition, it included the interventions (measures) carried out in the study in order to fix the problem, and also how data were collected and analysed (pre- intervention and post-intervention data collection/analysis).

3.1 Setting of the Study

The study took place in Savelugu Municipal Assembly Junior High School. The catchment areas (communities that feed the school with students) include Savelugu Township, Bunglung, Nanton-Kurugu, Yemo, Young, Yiwogu, among others. The school is located within Savelugu town in the Savelugu- Nanton Municipality in the northern region of Ghana. The municipality shares boundaries with West Mamprusi district in the north; Karaga district in the east; Kumbungu district in the west; and Tamale metropolis in the south. The population of Savelugu is about sixty-thousand people and majority of them are farmers and petty traders. Dagombas constitute majority of the population whiles Mossi, Frafra, Mamprusi and other minority tribes form insignificant percentage of the population.

3.2 Research Design

The design for the study was an action research. Action research could be described as a research whose purpose is to solve a specific problem or improve practice at a single local site. Since the study sought to bring about a change (improvement) of participants' performance, action research design was the best option for this study as against the conventional/traditional types of research It is worth nothing that the argument is not about which one (action research or traditional/conventional research) is better than the other but the question is which of them is suitable to be adopted at a specific time in a given situation.

The design included a pre-intervention test/situation analysis (assessment), intervention (treatment), and a post-intervention test (assessment) as well as observation of participants during the entire study. This practical action research method was adopted for the study since the researcher sought to fix a specific identified learning problem in the classroom.

3.3 Population of the Study

The population of the study consists all Junior High Schools within the Savelugu Municipality. The target population consists all students of Savelugu Municipal Junior High School (Savelugu M/A JHS).

3.4 Sample and Sampling Techniques

A purposeful sampling technique was to select JHS 3 students for the study because the problem was identified in that class. The class is made up of 40 students, 27 boys and 13 girls. These students aged between 15 to 20 years. A simple random sampling technique was then employed to select 12 students from the class of which 5 were girls and 7 were boys representing 30% of the class size. This sample size was chosen because the subjects are fairly homogenous in terms of the attribute under consideration hence the subjects could be selected for study without being bias. It was not also practicable to use the entire class for the study because of logistics constraints. The lottery method was employed in the selection of the subjects.

3.5 Data Collection Instruments

The instruments used for the gathering of the data were questionnaire, test, and observation guide. These were self-designed and given to the supervisor to check for issues of validity. The questionnaire consisted of two parts, A and B. Part A was further divided into two sections, 1 and 2. Section1 contained the background information on participants while section 2 dealt with the theory of the concepts of the physical quantities on pre-intervention and post intervention stages. Part 'B' also contained section '1' and section '2'. The section '1' focused on the background information on participants. The section '2' on the other hand, was based on practical activities on measuring physical quantities (practical test). Whiles the theory (written) test tasked participants to explain the concepts of physical quantities (length, area, temperature, mass, weight, and volume) as they apply to measurement, the practical test, on the other hand, engaged participants to measure given physical quantities using the appropriate measuring instruments such as measuring tapes, electronic balance, thermometers, spring balance, measuring cylinders e t c.

Participant observation approach was also used to collect data in the study. The observation guides were designed and used to observe participants' interest/commitment level to the study. Also, the accuracy levels of participants' measurements and any other emerging issues were observed. This approach afforded the researcher an opportunity to get first-hand information/experience on the participants' performance.

3.6. Data Collection Procedure

Permission was granted by the authorities of the school to carry out the study after an initial interaction with the head of the school. As one of the characteristics of action research, data was collected and analyzed as the study was being carried out from beginning to end. Therefore, data were being collected and analyzed during pre-intervention, during intervention, and post- intervention stages. Intervention measures were administered to the participants with the aim of improving their performance in measuring physical quantities. The researcher dealt with both secondary and primary data. The secondary data were collected during the literature review. The primary data on the other hand, which were collected by the researcher himself on participants directly, took place during the main research study. This was done as the research study was being conducted in the classroom. Therefore, the source of the primary data in this study was from field work (from participants).

The data collection/analysis approach was the mixed type - qualitative and quantitative approaches. It is worth noting that the qualitative approach was mainly used, from beginning to end, whiles the quantitative approach was only used in the summary of the data presentation and analysis in the form of percentages and simple tables, since the nature of action research is more qualitative than quantitative. The mixed approach was adopted on the following grounds. First, it afforded the researcher an opportunity to narrate and used non-textual information that could add meaning to the numeric data; and the numeric data could also add precision to the narrative and non-textual information. In addition, the approach could provide stronger, more robust evidence to support the conclusion and the recommendations.

3.7 Data Presentation and Analysis Plan

The tools for the data analysis included simple tables and content discussion. The simple tables and the content discussion were appropriate tools for presenting and analyzing data in the study based on the following grounds. The study was an educational action research which does not necessarily require complex data analysis tools unlike in the case of studies involving the social sciences which requires statistical package for social sciences (SPSS). Simple tables and content discussion on the data were enough to thoroughly present and analyse the data in the study.

The tables were used to present data on students' responses to the questionnaires, test scores, as well as the observation made on students' interest and commitment to the study. The content discussion was used to analyse the data under each table.

3.8 Data Quality (Validity & Reliability) and Ethical Issues

To ensure data quality, experts in research tools construction including the supervisor and some lecturers were consulted. Pilot questionnaires were given to them to read through to offer constructive criticisms which helped to improve the quality of data taking into consideration reliability and validity of question items. Appropriate modifications were made to the questionnaires. Wrong questions were discarded and ambiguous questions were reconstructed whiles the appropriate ones were maintained. That measure helped to elicit valid and reliable responses from participants which brought about quality data.

Ethics in educational action research could be described as the code and conduct (guidelines) of behaviour governing the conduct of research. The researcher, in considering the guidelines, ensured voluntary participation of participants in the study. In addition, safety measures were provided for participants in order to avoid any harm during the study, as well as ensuring confidentiality of information given by respondents. Also, the researcher ensured that the questionnaire did not constitute any sensitive questions that could cause harassment and/or cause uncomfortable feelings. The researcher and participants as well as the school authorities resolved that the data collected on the participants (students) and the staff by the researcher should be treated as confidential. In addition, the researcher assured the school authorities that the study was to be used for educational purpose only to the benefit of the participants and other students and teachers as well.

3.9 Pre-intervention Stage Data Collection

Students were given test to write to explain the meaning of the concepts of the physical quantities (length, mass, weight, volume, temperature, and area of objects/bodies). The scripts were then marked, recorded and analysed. In addition, the participants were then assigned to measure the physical quantities using the appropriate measuring instruments. Their work was assessed and recorded.

3.10 Intervention

As a major feature of an action research, an intervention was adopted in which activity-oriented method was employed to expose the students to practical work in measuring physical quantities in order to improve their performance in that respect. Demonstration method and group work were incorporated in the activity-oriented method. The intervention took place in the classroom and on the school premises during normal instructional periods. The measures were administered in 12 separate lessons within a month. At this stage series of activities were executed with participants in order to fix the problem under consideration as follows:

Intervention one: explaining the concepts of given physical quantities

(Length, area, mass, weight, volume, and temperature)

Materials needed: charts depicting the concepts of the physical quantities under consideration.

Activity 1: with the aid of charts, through discussion and illustrations, participants were helped to explain the concepts of length, area, mass, temperature, weight, and volume.

Activity 2: Students were then put into groups of four and were tasked to explain, in writing, the concepts of length, area, mass, temperature, weight, and volume. Each group was allowed to read their work to the entire participants in turns during which the researcher corrected their mistakes.

Activity 3: Each participants was asked to explain the concepts of length, area, mass, temperature, weight, and volume. The participants works were assessed and corrected.

Intervention two: measuring length of objects/distance

Materials needed: rules, measuring tapes, pencil/pen, and paper.

Activity 1**:** Using a rule and a tape measure, it was demonstrated to participants on how length of objects such as the length of a table, the length of a classroom, and the length of a football field are measured in centimetres, inch, feet, and metres respectively as follows: The measuring tape/rule is placed on the object whose length is to be measured. Then the zero mark on the measuring tape is placed to coincide with one end of the object. The required length of the object is the mark on the measuring tape/rule that coincides with the other end of the object.

.***Activity 2***: Participants were put into groups of four to measure the length of given objects/distance and record the measurement on the papers provided. Each group was allowed some time to demonstrate to the class how they measured the given objects/distance during which their mistakes were corrected.

Activity 3: Students were individually assigned to measure the lengths of given objects/distance on their own using rules and measuring tapes. The participants that encountered some difficulties were assisted to do it right.

Intervention three: measuring area of plane surfaces.

Materials needed: rules, measuring tapes, pencil/pen, and paper.

Activity 1: It was demonstrated to participants on how the area of plane surfaces such as the top of a table, the floor of a classroom, and the floor of a football field are measured using rules, and measuring tapes as indicated below. The length and the breadth of the table top was measured by using the measuring tape/rule and then recorded on the paper by using the pencil/pen. Then the length is multiplied by the breadth to get the surface area of the top of the table, using the relation; Area = length × breadth.

Activity 2: Students were put into groups of four and were assigned to measure the surface area of given rectangular shapes using rules and measuring tapes under the guidance of the researcher.

Activity 3: Students were individually tasked to measure the surface area of given rectangular shapes using rules and measuring tapes during which the researcher corrected their mistakes.

Intervention four: measuring body-temperature of the human being.

Materials needed: digital thermometer/ liquid-in-glass thermometer, cotton wool, spirit, pen, and paper.

Activity 1: Using the digital and the liquid-in-glass thermometers, the researcher demonstrated to participants how axial temperature (measuring temperature through the armpit) of the human body is determined as follows:

Using the digital thermometer:- the thermometer is set to the zero point. The armpit of the person whose temperature is to be measured and the sensor of the thermometer are cleaned with the spirit using the cotton wool. Then the thermometer is put under his/her armpit for about 3-5 minutes within which time the thermometer reads the temperature of the body and which is displayed on the screen of the thermometer following a beep, and then it is recorded as the temperature of the person.

Using the liquid-in-glass thermometer:- the thermometer is set to a point below 35 degrees Celsius by shaking it. The thermometer is then put under the armpit of the person whose temperature is to be measured after cleaning his/her armpit and the sensor of the thermometer with spirit using the cotton wool. Within 3-5 minutes the liquid (mercury/alcohol) in the thermometer rises. The corresponding value of the thermometer that coincides with the liquid (mercury/alcohol) is recorded as the temperature of the person. The average temperature of a normal person is about 37 degrees Celsius.

Activity 2: Students were put into groups of four and were guided by the researcher to measure the axial (armpit) body temperature in degrees Celsius of their colleagues using the digital and then the liquid-in-glass thermometers.

Activity 3: Students were then individually tasked to take the axial temperature of their colleagues using the digital and then the liquid-in-glass thermometers under the guidance of the researcher. The measurement was repeated for at least two times in order to ascertain the accuracy of the measurement.

Intervention five: measuring volume of regular solid objects.

Materials needed: rules, measuring tape, pencil/pen, and paper, and concrete blocks.

Activity 1: the researcher demonstrated to students how volume of regular solid objects such as regular concrete blocks are measured using rules and measuring tapes as follows:

The length, the breadth, and the height of the object were measured by using the measuring tape/rule and recorded. The volume of the object was then determined by calculating the product of its dimensions by adopting the relation; $Volume = length \times breadth \times height$.

Activity 2: the researcher put participants into groups of four and guided them to measure the volume of given regular solid objects using rules and measuring tapes.

Activity 3: the researcher then guided participants individually to measure the volume of given regular solid objects using rules and measuring tapes.

Intervention six: measuring volume of irregular solid objects that sink in water

Materials needed: measuring cylinder, water, irregular solid objects (stones), thread, pencil or pen.

Activity 1: the researcher demonstrated to participants how irregular solid objects are measured as indicated below.

Water was poured into the measuring cylinder at a suitable level and recorded the volume as $\mathbf{V_1}$. The thread was tied to the irregular solid shape and carefully immersed it into the water in the cylinder holding the thread. The irregular solid displaced some water upwards to a new level which was recorded as $\mathbf{V_2}$. The volume of the irregular solid shape was determined by subtracting $\mathbf{V_1}$ from $\mathbf{V_2}$. Therefore, volume of irregular solid object was determined by the relation; $\mathbf{V = V_2 - V_1}$.

Activity 2: Participants were put into groups of four and were guided by the researcher to measure volumes of given irregular solid objects that sink in water using cylinders, water, stones, pencil/pen, and thread.

Activity 3: participants were individually guided by the researcher to determine the volume of irregular solid objects using cylinders, water, stones, thread and pencil/pen.

Intervention seven:- measuring volume of liquid substances.

Materials needed: measuring cylinders, water, pipette.

Activity 1**:** the researcher demonstrated to participants how the volume of liquid substances are measured, using measuring cylinders, water, and pipette as indicated bellow. Water is drawn into the pipette and then discharged into the measuring cylinder. The calibrated mark that corresponded with the level of the water was read and recorded as the volume of the water. The reading was done at the meniscus at 90 degrees eyed level.

Activity 2: the researcher put students into groups of four and guided them to measure volume of given liquid substances using measuring cylinders, water and pipette.

Activity 3: the researcher guided participants individually to measure the volume of given liquid substances using measuring cylinders, water, and pipette.

Intervention eight: measuring mass of substances/bodies/objects using **electronic/direct reading balance**

Materials needed: electronic balance/direct reading balance, paper, pen, substances/objects whose mass are to be determined.

Activity 1: The researcher demonstrated to participants how the mass of a body is determined using electronic balance/direct reading balance as follows:

The balance is reset to the zero point and put on a level ground. The body whose mass is to be determined is carefully put on the balance (scale). The mass of the body is displayed on the screen (in the case of the digital electronic balance), and then it is recorded. For the direct reading balance, the pointer reading is taken as the mass of the body.

Activity 2: Participants were put into groups of four and were guided by the researcher to determine the mass of given substances/bodies using electronic balance and direct reading balance.

Activity 3: participants were then individually guided by the researcher to measure the mass of given substances/bodies using the electronic balance and the direct reading balance.

Intervention nine; measuring weight of bodies/objects using the dial spring balance

Materials needed: spring balance/dial spring balance, hanger/rope, bodies/objects whose mass is to be determined.

Activity 1: the researcher demonstrated to participants how the weight of bodies/objects is measured using the dial spring balance as indicated below:

The ring of the spring balance is hanged to a wooden/metal bar with a rope at a suitable height. The body/object whose mass is to be determined is hanged onto the hook of the spring balance. The force of gravity pulls the body/object towards the ground. The pointer reading of the balance is recorded as the weight of the body/object.

Activity 2: the researcher put participants into groups of four and guided them to measure the weight of given bodies/objects using the dial spring balance.

Activity 3: the researcher guided individual participants to measure the weight of given bodies/objects using the dial spring balance.

3.11 Post-intervention Data Collection and Analysis

At this stage, participants' performances were analysed to find out whether or not the intervention that was implemented was successful. Participant's performances were measured by administering both theory and practical tests, one at a time. The theory questions were based on the explanation of the concepts of length, area, temperature, mass, weight, and volume as they apply to measurement of physical quantities. The practical test on the other hand, engaged participants to individually measure the length, mass, area, temperature, weight, and volume of given physical quantities using the appropriate measuring instruments. Participants performances were analysed. Participant observation approach was also employed to collect the data. A guide was designed to observed participants' commitment/interest to the whole process and accuracy of measurement and any other emerging interest. This afforded an opportunity to get firt-hand information on participants' performance.

3.12 Conclusion

In this chapter, the setting, the design, and the population of the study are clearly dealt with. The chapter also showed how the researcher dealt with the sample and sampling technique, data collection instruments, data collection procedure, data analysis plan, ethical issues, as well as intervention measures.

CHAPTER FOUR

PRESENTATION, ANALYSIS AND DISCUSSION OF RESULTS

4.0 Introduction

This chapter dealt with presentation and analysis of data which involved tables and description of participants' performances/behaviours. It also included research findings and discussion of the findings.

4.1 Presentation and Analysis of Data

The presentation and analysis of data is sub-divided into pre-intervention data analysis (situation analysis), post-intervention data analysis, and observation during the entire study as well as summary of the analyzed data.

4.1.1 Pre-intervention Data Analysis (Situation Analysis)

A) Presentation and analysis of participants' understanding on the concepts of the given physical quantities.

Participants' understanding on the concepts of the physical quantities was tested to ascertain the significance of the research problem/topic. They were tasked to write down the meaning of the concepts 'length', 'area', 'mass', 'weight', 'volume', and 'temperature'. The following revelations, as indicated in table 4.2, were observed after their scripts were marked. None of the 12 participants could explain the concept 'area' whiles as many as eleven of them could not explain the meaning of volume. In addition, ten of them could not write down the meaning of length. Eight out of the 12 participants however, were able to explain the concept of temperature whiles nine could not write down the meaning of weight. Finally, as many as ten of the participants, could not explain the concept of mass.

Table 4.1: Performance on Concepts of given Quantities--pre-intervention Test

Participant	Length	Area	Mass	Weight	Temperature	Volume
A	X	X	X	X	Y	X
B	X	X	X	X	X	X
C	X	X	Y	Y	X	X
D	Y	X	X	X	Y	X
E	X	X	X	Y	Y	X
F	X	X	X	Y	Y	X
G	X	X	X	X	Y	X
H	X	X	X	X	Y	X
I	X	X	X	X	X	X
J	X	X	X	X	Y	X
K	Y	X	Y	X	Y	Y
L	Y	X	Y	X	Y	Y

Source: Field work, March, 2017.

Key: ***Y*** -- *means participant was able to give correct explanation.*

X -- *means participant could not give correct explanation or had no idea at all.*

In order to answer the research question *'What could be responsible for the inability of the students to understand the concept of measurement of physical quantities in integrated science?'*, questionnaires were administered to participants and elicited the following responses as presented in table 4.1

Five participants claimed that they were taught the concept of length but they didn't understand it because the teacher used lecture method when they were in form-one. Two of them indicated that they were not in school when it was being treated. One of them said he didn't show interest in the lessons when it was being treated because measuring instruments were not being used whiles another participant maintained that he was not taught at all. Six participants said that they were taught the concept of area but they didn't understand it because the teacher used lecture method whiles three of them said that they were not taught at all. One participant claimed he was not in school when it was treated. Six participants indicated that they were taught the concept of mass but they didn't understand it because the teacher used lecture method whiles two of them said they were not in school when it was treated.

One participant said he was not taught at all. Five of the participants maintained that they were taught the concept of weight but they didn't understand it because the teacher used lecture method. Two of them said they were not taught at all whiles one of them claimed he was not in school when it was treated. Two of the participants said they were taught the concept of temperature but they couldn't understand it because the teacher used lecture method whiles another two of them claimed they were not in school when it was treated. One of them said he was not taught at all. Five of the participants claimed that they were taught the concept of volume but they didn't understand it because the teacher used lecture method whiles four of them maintained that they were not in school when it was treated. One of them said he was not taught at all.

Table 4.2: Participants' Responses on why they could not explain the given Concepts

Participant	Length	Area	Mass	Weight	Temperature	Volume
A	[V]	[V]	[V]	[V]	[ ]	[V]
B	[Q]	[V]	[V]	[Q]	[Q]	[Q]
C	[V]	[V]	[ ]	[ ]	[Q]	[V]
D	[ ]	[V]	[V]	[V]	[ ]	[V]
E	[V]	[V]	[V]	[ ]	[ ]	[Q]
F	[V]	[V]	[V]	[ ]	[ ]	[V]
G	[V]	[R]	[Q]	[V]	[ ]	[Q]
H	[R]	[R]	[R]	[R]	[ ]	[R]
I	[V]	[V]	[V]	[V]	[ ]	[V]
J	[W]	[R]	[V]	[R]	[ ]	[V]
K	[Q]	[Q]	[Q]	[ ]	[ ]	[Q]
L	[ ]	[Q]	[ ]	[Q]	[ ]	[ ]

Source: Field Work, March, 2017.

Key: *[V]-- means, 'I was taught but I didn't understand it because the teacher used lecture method'..*

[R] -- *means, 'I was not taught at all'.*

[W] -- *means, 'I didn't show interest in the lesson when I was being taught because appropriate measuring instruments were not being used'.*

[Q]-- *means, 'I was not in school when it was treated'.*

[Z]-- *means, 'any other reason'.*

[ ] -- *means, participant answered the question well.*

B) Presentation and analysis of participants' performance on measurements of given physical quantities using the appropriate measuring instruments - pre-intervention stage.

The results of the participants' performances, as indicated in table 4.4 below, revealed the following analysis. Seven out of the 12 participants could not measure the lengths of given objects/distances whiles as many as nine of them could not measure the quantity of a given area accurately. Similarly, ten of the participants could not measure the weight of the given substances whiles nine of them could not measure the mass of given objects. Eight of them, however, were able to measure the volume of regular solid shapes but as many as eight participants could not measure the temperature of human bodies.

Table 4.3: Participants' Performance on Measuring given Physical Quantities--pre-intervention test

Participant	Length	Area	Mass	Weight	Temperature	Volume		
						V_1	V_2	V_3
A	[P]	[P]	[P]	[P]	[V.P]	[P]	[P]	[V]
B	[G]	[P]	[P]	[P]	[V.P]	[P]	[P]	[V]
C	[P]	[P]	[P]	[P]	[G]	[G]	[G]	[P]
D	[G]	[P]	[P]	[G]	[V.P]	[G]	[G]	[P]
E	[P]	[P]	[P]	[P]	[G]	[G]	[G]	[P]
F	[P]	[P]	[P]	[P]	[V.P]	[G]	[G]	[P]
G	[G]	[P]	[P]	[P]	[V.P]	[G]	[G]	[P]
H	[G]	[P]	[P]	[G]	[G]	[P]	[V.P]	[V.P]
I	[P]	[P]	[G]	[P]	[V.P]	[P]	[P]	[P]
J	[G]	[P]	[P]	[P]	[V.P]	[G]	[G]	[P]
K	[P]	[P]	[V.G]	[P]	[P]	[V.G]	[V.G]	[P]
L	[V.G]	[V.G]	[G]	[P]	[G]	[V.G]	[V.G]	[P]

Source: Field Work, March, 2017.

Key: ***V.G*** -- *Means participant executed almost all aspects of the measurement accurately.*

G -- *Means participant did well but couldn't execute certain aspects of the measurement accurately.*

P -- *Means participant couldn't execute most of the measurement accurately.*

V.P -- *Means participant had no idea at all.*

In order to find answers to the research question *'Why is it difficult for the students to acquire the requisite skills in measuring physical quantities?'*, questionnaires were used to gather following responses from participant as presented in table 4.5. Six participants maintained that they were not taught how to use measuring instruments to measure length whiles two of them said they were not taught how to measure length at all. One said he/she did not show interest in the lesson when it was being treated because the teacher used lecture method and another participant claimed he was not in school when it was treated. For the measurement of area, seven of them indicated that they were not taught how to use measuring instruments whiles three of them said they were not taught at all. Two participants claimed that they were not in school when it was treated. Four participants maintained that they were not taught how to use measuring instruments to measure weight of substances and two of them said they were not in school when it was treated whiles another two said they were not taught at all.

Two of them indicated that they were not in school when it was treated and one person claimed he was not taught how to use measuring instruments to take temperature of human bodies. Seven participants maintain that they were not taught how to use measuring instruments to measure masses of nuisances whiles two of them said they were not in school when it was treated. One person indicated that he was not taught at all. For the measurement of volume, six of the participants said they were not taught how to use measuring instruments to determine weight of volume of substances. Four of them maintenance that they were not in school when it was treated whiles one person indicated that he was not taught at all.

Table 4.4: Participants' responses on why they could not measure the given physical quantities

Participant	Length	Area	Mass	Weight	Temperature	Volume
A	[V]	[V]	[V]	[V]	[ ]	[V]
B	[Q]	[V]	[V]	[Q]	[Q]	[Q]
C	[V]	[V]	[ ]	[ ]	[Q]	[V]
D	[ ]	[V]	[V]	[V]	[ ]	[V]
E	[V]	[V]	[V]	[ ]	[ ]	[Q]
F	[V]	[V]	[V]	[ ]	[ ]	[V]
G	[V]	[R]	[Q]	[V]	[ ]	[Q]
H	[R]	[R]	[R]	[R]	[ ]	[R]
I	[V]	[V]	[V]	[V]	[V]	[V]
J	[W]	[R]	[V]	[R]	[ ]	[V]
K	[Q]	[Q]	[Q]	[ ]	[ ]	[Q]
L	[ ]	[Q]	[ ]	[Q]	[ ]	[ ]

Source: Field Work, March, 2017.

Key: *[V] -- Means, 'I was not taught how to use the instrument to measure the quantities'.*

[R]-- means, 'I was not taught at all'.

[W] -- means, 'I didn't show interest in the lesson when I was being taught because the teacher used lecture method'.

[Q]-- means, 'I was not in school when it was treated'.

[Z]-- means, 'any other reason'.

[ ] -- means, participant were able to measure the given quantity.

4.1.2 Post-intervention data Presentation and Analysis

In order to assess the impact of the intervention on the participants performance in understanding the concepts of quantities in measurements, written tests were conducted for the participants to explain the concepts 'length', 'area', 'mass', 'temperature', volume', 'weight'.

A) *Analysis of participants' performance on explanation the concepts of given quantities.*

All the participants were able to give the meaning of the concepts 'length', 'area', 'mass', and 'temperature'. Eight out of the 12 participants were able to explain the concepts of weight and volume correctly whiles four of the participants demonstrated having the concept 'weight' but gave the explanations with errors.

Table 4.5: Participants' Performance in explaining the Concept of given Physical Quantities Post-intervention Test

Participant	Length	Area	Mass	Weight	Temperature	Volume
A	[Y]	[Y]	[Y]	[Y]	[Y]	[X]
B	[Y]	[Y]	[Y]	[Y]	[Y]	[X]
C	[Y]	[Y]	[Y]	[S]	[Y]	[Y]
D	[Y]	[Y]	[Y]	[Y]	[Y]	[Y]
E	[Y]	[Y]	[Y]	[Y]	[Y]	[Y]
F	[Y]	[Y]	[Y]	[S]	[Y]	[Y]
G	[Y]	[Y]	[Y]	[Y]	[Y]	[Y]
H	[Y]	[Y]	[Y]	[Y]	[Y]	[Y]
I	[Y]	[Y]	[Y]	[X]	[Y]	[X]
J	[Y]	[Y]	[Y]	[S]	[Y]	[X]
K	[Y]	[Y]	[Y]	[Y]	[Y]	[Y]
L	[Y]	[Y]	[Y]	[Y]	[Y]	[Y]

Source: Field Work, March, 2017.

Key: Y -- means participant were able to give correct explanation of the concept.

S -- Means participant had the idea but could not express it in writing vividly.

X -- Means participant could not give correct explanation of the concept.

B) Analysis of participants' performance on measurement of given physical quantities using the appropriate measuring instruments -- post-intervention data analysis.

Table 4.7 illustrates the performance of participants on measurements of given physical quantities using the appropriate measuring instruments. Indeed, all the participants demonstrated, at different levels, that they have acquired the requisite knowledge and skills in measuring the given physical quantities. For the measurement of length, 5 of the participants performed excellently whiles 6 of them did very well and one person did well. 3 of the participants were able to measure the area of given objects excellently whiles nine of them did very well. As many as ten participants measured the given mass excellently and 2 of them did very well. For the measurement of weight, 6 of them performed excellently, 2 did very well and four did well. 5 participants were able to measure the temperature of human bodies excellently whiles 7 of them did very well. 3 of the participants were able to measure the volume of solid regular objects excellently whiles 8 participants did very well and one person did well in that respect. As many as eight of the participants performed excellently in measuring given volume of liquid substances whiles 4 participants did very well. Finally, 5 participants excelled in the measurement of volume of solid irregular objects that sink in water and 7 of them did very well in that respect.

Table 4.6: Participants' performance in measuring given physical quantities-- post-intervention test.

Participant	Length	Area	Mass	Weight	Temperature	Volume		
						V_1	V_2	V_3
A	[E]	[V.G]	[E]	[G]	[V.G]	[E]	[E]	[E]
B	[V.G]	[E]	[E]	[V.G]	[E]	[V.G]	[E]	[V.G]
C	[G]	[V.G]	[E]	[E]	[V.G]	[V.G]	[E]	[V.G]
D	[E]	[E]	[E]	[V.G]	[E]	[E]	[E]	[V.G]
E	[V.G]	[V.G]	[E]	[G]	[V.G]	[G]	[V.G]	[V.G]
F	[V.G]	[V.G]	[V.G]	[E]	[V.G]	[V.G]	[V.G]	[V.G]
G	[V.G]	[V.G]	[E]	[E]	[E]	[V.G]	[E]	[V.G]
H	[E]	[V.G]	[E]	[G]	[V.G]	[V.G]	[E]	[E]
I	[V.G]	[V.G]	[E]	[G]	[V.G]	[V.G]	[E]	[G]
J	[V.G]	[V.G]	[E]	[E]	[V.G]	[V.G]	[V.G]	[E]
K	[E]	[V.G]	[V.G]	[E]	[E]	[V.G]	[V.G]	[E]
L	[E]	[E]	[E]	[E]	[E]	[E]	[E]	[E]

Source : Field work, March,2017.

Note! *V_1 and V_2 represent volume of solid regular objects and volume of liquid substances respectively whiles V_3 stands for volume of solid irregular objects that sink in water.*

Key: ***E*** *-- Means, participant were able to execute the measurement accurately.*

V.G *-- Means, participant executed almost all aspect of the measurement accurately.*

G *-- Means, participant did well but couldn't execute certain aspects of the measurement accurately.*

4.1.3 Summary of data presentation and analysis - explanation of given concepts

Comparison of participants' pre-intervention performance with that of the post-intervention indicated that the intervention yielded positive results. As indicated in the table 4.8 only two participants could explain the concepts of length and mass each before the intervention, representing 16.6 percent each on the sample size of 12 . On the contrary, all the 12 participants could explain each of those concepts after the intervention, representing 100 percent each.

Furthermore, none of them could explain the concept ‘area’ before the intervention, representing zero percent but the same 12 participants were able to explain that concept after the intervention, representing 100 percent. Also, only three participants could explain ‘weight’ as a concept before the intervention, representing 25 percent whiles as many as eight of them could explain that concept after the intervention, representing 66.6 percent. In addition, for the concept of volume, only one participant could give correct explanation before the intervention, representing 8.3 percent. Conversely as many as eight of them were able to explain the concept after the intervention representing 66.6 percentage. Finally, eight participants were able to explain ‘temperature’ before the intervention, representing 66.6 percent whiles all of them gave correct explanations after the intervention, representing 100 percent. It is worth noting that the researcher had to repeat some aspects of the interventions before some participants could get it right.

Table 4.7: Summary of participants' performance in explaining the concepts of given physical quantities in measurement --pre-intervention versus post-intervention:-

Pre-intervention results ***Versus*** **Post-intervention results**

Quantity	Pre-Intervention No. of participants that could explain the concept.		Post-intervention No. of participants that could explain the concept.	
LENGTH	2	16.6 %	12	100 %
AREA	0	0 %	12	100 %
MASS	2	16.6 %	12	100 %
WEIGHT	3	25 %	8	66.6 %
VOLUME	1	8.3 %	8	66.6 %
TEMPERATURE	8	66.6%	12	100 %

Source: Field Work, March, 2017.

4.1.4 Summary of Data Presentation and Analysis - Measurement of given Quantities

Comparing participants' pre-intervention performance with that of the post-intervention indicated that students' performance did improved significantly after the intervention. As indicated in table 4.9 only 5 participants could measure the length of given objects before the intervention representing 41.6 % whiles all of them were able to measure those concepts after the intervention, representing 100%. For area and mass, only 3 of them could measure each of those concepts before the post-intervention representing 25% each but all of them were able to measure the those concepts after the post-intervention, representing 100%

Four of the participants could measure temperature of the human body before the intervention representing 33.3 percent whiles all of them could measure the quantity after the intervention, representing 10 percent. Only two participants could measure the quantity of weight before the intervention representing 16.6 percent but all of them were able to measure that quantity after the intervention representing 100 percent. For volumes of regular solid objects and liquid substances, eight participants were able to measure each of them before the intervention, representing 66.6 percent each. On the contrary, all the 12 participants could measure those quantities after the intervention, representing 100 percent. None of the participants could measure volume of irregular solid objects before the intervention, representing zero percent but all of them were able to measure that quantity after the intervention, representing 100 percent. The high success rate of participants performance was partly attributed to repeated intervention measures.

Table 4.8: Summary of participants' performance in measuring given physical quantities -- pre-intervention versus post-intervention

Pre-intervention results ***Versus*** **Post-intervention results**

Quantity	Pre-Intervention No. Of participants that could measure the quantity.		Post-Intervention No. of participants that could measure the quantity	
LENGTH	5	41.6 %	12	100 %
AREA	3	25 %	12	100 %
MASS	3	25 %	12	100 %
WEIGHT	2	16.6 %	12	100 %
TMPERATURE	4	33.3 %	12	100 %
VOLUME 1	8	66.6%	12	100 %
VOLUME 2	8	66.6 %	12	100 %
VOLUME 3	0	0 %	12	100 %

Source: Field work

Note! *V_1 and V_2 represent volume of solid regular objects and volume of liquid substances respectively whiles V_3 stands for volume of solid irregular objects that sink in water.*

4.1.5 Observation

In order to assess participants' interest and commitment level in the study, An observation guide was adapted and the following observation were made as the study was being conducted. Seven of the participants were very committed to the study whiles three others were fairly interested/committed to the study as they would absent themselves from school occasionally. Two of the participants' interest/commitment level was not encouraging as they would not only come to school regularly but they would not also sit in class to take full part in the study. Additional times had to be made for them and they were persuaded to go through the study successfully. In addition, some participants needed more time for guidance and practice in order for them to master certain measurement skills. Also, most of the participants found it hard to distinguished the concepts of weight and mass as well as their units of measurements during pre-intervention and intervention stages.

Table 4. 9: Observation guide: participants' interest / commitment level to the study.

Participant	Very Committed	Committed	Not Committe
A		[√]	
B	[√]		
C	[√]		
D	[√]		
E			[√]
F	[√]		
G	[√]		
H		[√]	
I	[√]		
J			[√]
K	[√]		
L		[√]	

Source: Field work, March, 2017.

4.2 Research Findings

The situational analysis as presented in tables 4.2 and table 4.4 showed that the participants did not have the concepts and the requisite skills in measuring physical quantities such as length, area, mass, weight, volume, and temperature In addition, it is shown in tables 4.3 and table 4.5 that the causes of their inability to explain and measure given physical quantities was attributed to the following : teaching without the appropriate teaching and learning materials (measuring instruments); lack of interest on the part of some students in the lessons during teaching and learning process; absenteeism on the part of some of the students when the concepts were being treated; inappropriate method of teaching; and some students maintained that they were never taught the concepts. Furthermore, it was observed that some of the participants lack basic arithmetic (addition, subtraction, multiplication, and division) which negatively affected their ability to calculate and measure quantities. Also, as indicated in the observation guide in table 4.8, the interest and commitment level of most of the participants were very high. Finally, the performance of participants' post-intervention tests did improve significantly.

4.3 Discussion on Findings

The research questions were restated and were related to the research findings and then discussed their relationships and what that meant for the study in the following ways.

Research Question 1*: What could be responsible for the inability of the students to explain meaning of the concepts of some physical quantities?*

Answer*: the students could not explain the meaning of the concepts due to the following; teaching without the appropriate teaching and learning materials (measuring instruments); lack of interest on the part of some students in the lessons during teaching and learning process; absenteeism on the part of some of the students when the concepts were being treated; inappropriate method of teaching; and some students maintained that they were never taught the concepts before.*

Research Question 2*: Why is it difficult for students to acquire the requisite skills in measuring physical quantities?*

Answer: *teaching without the appropriate teaching and learning materials (measuring instruments); inappropriate method of teaching*

After confirming participants' difficulty in understanding the concepts and skills in that regard through pre-intervention test, the researcher elicited their responses to reasons why the respondents did not have the concepts and the requisite skills in measuring physical quantities. The responses raised the following: teaching without the appropriate measuring instruments (TLMS), lack of interest on the part of some of the participants when the concepts were being treated, absenteeism on the part of students, inappropriate method of teaching the concepts, and the fact that some students said they were never taught the concepts at all. To address those problems, the participants were engaged in an appropriate teaching method (activity-oriented method of teaching physical quantities) in which appropriate teaching/learning materials were used. The method boosted interest of participants in the lesson and helped minimised absenteeism among them.

Research Question 3*: Can the students measure the physical quantities as a result of the intervention?*

Answer: Participants were engaged in series of practical activities and were guided by the researcher to measure physical quantities using the appropriate measuring instruments and methodology (activity-oriented method). This afforded participants opportunity to take active part in the lessons and manipulated with measuring instruments, thus making it lovely and interesting which helped them to be able to explain the concepts and acquired the skills in measuring physical quantities.

In addition, most of the participants interest and commitment level were very high which contributed to the success of the study. Participants' results of the post-intervention tests indicated a positive impact of the intervention on participants' performance as far as measuring physical quantities are concerned.

In short the impact of the study on participants' performance in understanding and measuring physical quantities cannot be over-emphasized.

4.4 Conclusion

In this chapter, analysis and presentation of data at the various stages (pre-intervention, intervention, as well as post-intervention stages) were captured in tables. It also included explanations and descriptions on participants' performance in the study. Also, it dealt with how the researcher observed the interest and commitment level of participants in the study with the help of observation guide. Participants' commitment level was high. In addition, it dealt with the research findings and its discussion.

CHAPTER FIVE

SUMMARY, CONCLUSION, AND RECOMMENDATIONS

5.0 Introduction

This chapter examined the summary of the entire study, the conclusion drawn in accordance with the research findings, and recommendations on the study.

5.1 Summary

The problem of the study stems from the fact that some students of Savelugu Municipal Assembly Junior High School had difficulties explaining and acquiring the skills in measuring physical quantities in integrated science. Therefore, the study sought to assist students to improve upon their performance in measuring physical quantities in integrated science. The study served the students well in solving their measurement problems and it is hoped that other students and teachers will also benefit from it.

The research questions were raised to give direction to the study. The questions sought to find out the causes for the problem under consideration. Significant findings for the study included inappropriate teaching method, teaching without the appropriate teaching/learning materials, absenteeism and lack of interest on the part of some students (participants) among others.

To get more insight into the subject matter of the research, literature was reviewed on the basic tenets of measurement, activity-oriented teaching method, demonstration method of teaching, and group method of teaching. Action research design which involved qualitative approach in presenting and analyzing data was adopted. Simple random sampling was used to select participants. Data collection instruments used in the study included questionnaires, tests, and observation guides. Intervention measures (activity-oriented teaching method) were taken by the researcher to fix the problem of the study. Analysis of the research findings were done by presenting data in tables and then described in detail. Finally, the purpose of the study, which was to improve the performance of students of Savelugu M /A JHS, was encouraging.

5.2 Conclusion

The use of the activity-oriented method of teaching, which was incorporated with demonstration and group methods of teaching, did improve students performance in measuring the given physical quantities in integrated science. Based on the findings of the study, it was concluded that inappropriate teaching methods, teaching without the appropriate teaching/learning materials, lack of interest in lessons on the part of the students, and students' absenteeism among others, contributed to the problem as stake. In addition, comparing participants' pre-intervention performance with that of the post-intervention as presented in tables 4.8 and table 4.9, it was concluded that there was an improvement on their performance as a result of the measures put in place by the researcher during the intervention stage. Based on that, it is concluded that the study achieved its purpose.

5.3 Recommendations

Though the study achieved its purpose, certain things need to be recommended. Only one each of the measuring instrument was used due to inadequate funds to procure more measuring instruments. That development made the group work difficult to conduct.

In the light of this, stake-holders of education should support schools with adequate teaching/learning materials.

Also, subsequent researchers who wish to study into this problem should make sure that they acquire enough measuring instruments in advance.

Furthermore, the dark conditions in the classrooms affected the readings of participants in carrying out the measurements. It is, therefore, recommended that classrooms be made bright enough to allow easy reading during measurement.

In addition, teachers should try to always use teaching/learning materials in their lessons to enhance students understanding.

Also, considering the workload involves in this kind of study, it is recommended that a study of this sort which involves much practical work can be easily and better conducted by two or more co-researchers instead of one person.

Finally, considering the significance of action research in education, educational institutions should support and encourage teachers and students to be conducting action research from time to time to improve their performances.

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APPENDICES

APPENDIX 'A'

DATA COLLECTION INSTRUMENT FOR RESEARCH STUDY
QUESTIONNAIRE FOR PARTICIPANT

Instructions: *please, read the questions below carefully and provide candid responses to each of the questions.*

PART 'A'

Section 1: Background Information about Respondent

1) Name of respondent..

i) Sex.........................   ii) Class/form..........................

iii) School ....

Section 2: Pre- Intervention Test Questions for Participants--Theory (Written Test)

1. Explain the following as they apply to measurement of physical quantities.

a) Length   b) Area   c) Mass   d) Temperature   e) Volume   d) Weight

Section 3: Instructions; Please, Tick [√] in the Space Provided below the Option that Corresponds with your Answer.

1. Can you explain the concept 'length' in measurement?   i) YES. [ ]   ii) NO. [ ]

2. If your response is 'NO', why not?

i) I was not taught at all [ ]   ii) I was taught but I didn't understand it. [ ]

iii) I did not show interest in the lessons when I was being taught. [ ]

iv) I was not in school when it was taught [ ]

V) Any other, specify...

3. Can you explain the concept 'area' in measurement? i) YES. [ ] ii) NO. [ ]

4. If your response is 'NO', why not?

i) I was not taught. [ ] ii) I was taught but I didn't understand it. [ ]

iii) I did not show interest in the lessons when I was being taught. [ ]

iv) I was not in school when it was taught. [ ]

v) Any other, specify...

5. Can you explain the concept 'mass' in measurement? i YES, [ ] ii NO [ ]

6. If your response is 'NO', why not?

i) I was not taught. [ ] ii) I was taught but I didn't understand it. [ ]

iii) I did not show interest in the lessons when I was being taught. [ ]

iv) I was not in school when it was taught. [ ]

v) Any other, specify...

7. Can you explain the concept 'weight' in measurement? i YES, [ ] ii NO [ ]

8. If your response is 'NO', why not?

i) I was not taught. [ ] ii) I was taught but I didn't understand it. [ ]

iii) I did not show interest in the lessons when I was being taught. [ ]

iv) I was not in school when it was taught [ ]

V) Any other, specify...

9. Can you explain the concept ‘temperature’ in measurement? i YES, [ ] ii NO [ ]

10. If your response is ‘NO’, why couldn’t you explain it?

i) I was not taught. [ ] ii) I was taught but I didn’t understand it [ ]

iii) I did not show interest in the lessons when I was being taught. [ ]

iv) I was not in school when it was treated. [ ]

v) Any other, specify..

11. Can you explain the concept ‘volume’ in measurement? i YES, [ ] ii NO [ ]

12. If your response is ‘NO’, why couldn’t you explain it?

i) I was not taught. [ ] ii) I was taught but I didn’t understand it [ ]

iii) I did not show interest in the lessons when i was being taught. [ ]

iv) I was not in school when it was treated. [ ]

v) Any other, specify..

PART ‘B’

Section 1: Pre-Intervention Test-Practical

Participants to be assigned to measure the quantities (length, area, mass, temperature, volume, weight) of given objects/bodies by using the appropriate measuring instruments provided.

Section 2: Please, Tick in the Space Provided below the Option that Corresponds with your Answer.

1. Can you measure the given ‘length’ accurately using the instruments provided?

i)YES. [ ] ii) NO. [ ]

2. If the response is ‘NO’, what accounted for that?

i) I was not taught. [ ] ii) I was not in school when it was being treated. [ ]

iii) I was not taught how to use the instruments to measure the quantity. [ ]

iv) I didn't show interest in the lesson when it was being treated. [ ]

v) Any other, specify...

3. Can you measure the given 'area' accurately using the instruments provided?

i)YES. [ ] ii) NO. [ ]

4. If the response is 'NO', what accounted for that?

i) I was not taught. [ ] ii) I was not in school when it was being treated [ ]

iii) I was not taught how to use the instruments to measure the quantity. [ ]

iv) I didn't show interest in the lesson when it was being treated. [ ]

v) Any other, specify...

5. Can you measure the given 'mass' accurately using the instruments provided?

i)YES. [ ] ii) NO. [ ].

6. If the response is 'NO', what accounted for that?

i) I was not taught. [ ] ii) I was not in school when it was being treated. [ ]

iii) I was not taught how to use the instruments to measure the quantity. [ ]

iv) I didn't show interest in the lesson when it was being treated. [ ] v) Any other, specify...

7. Can you measure the given 'weight' accurately using the instruments provided?

i) YES. [ ] ii) NO. [ ]

8. If the response is 'NO', what accounted for that?

i) I was not taught at all [ ] ii) I was not in school when it was being treated. [ ]

iii) I was not taught how to use the instruments to measure the quantity. [ ]

iv) I didn't show interest in the lesson when it was being treated. [ ]

v) Any other, specify...

9. Could you measure the given 'volume' accurately using the instruments provided?

i) YES. [ ] ii) NO. [ ]

10. If the response is 'NO', what accounted for that?

i) I was not taught. [ ] ii) I was not in school when it was being treated. [ ]
iii) I was not taught how to use the instruments to measure the quantity. [ ]
iv) I didn't show interest in the lesson when it was being treated. [ ]
v) Any other, specify..

11. Could you measure the given 'temperature' accurately using the instruments provided?

i)YES. [ ] ii) NO. [ ]

12. If the response is 'NO', what accounted for that?

i) I was not taught. [ ] ii) I was not in school when it was being treated. [ ]
iii) I was not taught how to use the instruments to measure the quantity. [ ]
iv) I didn't show interest in the lesson when it was being treated. [ ]
v) Any other, specify..

APPENDIX 'B'

OBSERVATION GUIDE

Level of interest/commitment of participants in the study

Level of Interest/Commitment for the Study

Participant	Very committed	Committed	Not committed
A	[ ]	[ ]	[ ]
B	[ ]	[ ]	[ ]
C	[ ]	[ ]	[ ]
D	[ ]	[ ]	[ ]
E	[ ]	[ ]	[ ]
F	[ ]	[ ]	[ ]
G	[ ]	[ ]	[ ]
H	[ ]	[ ]	[ ]
I	[ ]	[ ]	[ ]
J	[ ]	[ ]	[ ]
K	[ ]	[ ]	[ ]
L	[ ]	[ ]	[ ]

APPENDIX ‘C’

DATA COLLECTION INSTRUMENT FOR RESEARCH STUDY; OBSERVATION GUIDE FOR THE RESEARCHER ON PARTICIPANTS

erformances in measuring given physical quantities using the appropriate measuring instruments

Parti	easuring ngth of a ven object	Measuring area of a given plane surface	Measuring temperature of a given body	Measuring mass of a given substance	Measuring weight of a given object	Measuring volume of a given regular solid substance	Measuring volume of a given liquid substance	Measuring volume of a given solid irregular substance
1.Par ‘A’	.G] [G]] [V.P]	[V.G] [G] [P] [V.P]	[V.G] [G] [P] [V.P]	[V.G] [G] [P] [V.P]	[V.G] [G] [P] [V.P]	[V.G] [G] [P] [V.P]	[V.G] [G] [P] [V.P]	[V.G] [G] [P] [V.P]
2.Par ‘B’	.G] [G]] [V.P]	[V.G] [G] [P] [V.P]	[V.G] [G] [P] [V.P]	[V.G] [G] [P] [V.P]	[V.G] [G] [P] [V.P]	[V.G] [G] [P] [V.P]	[V.G] [G] [P] [V.P]	[V.G] [G] [P] [V.P]
3.Par ‘C’	.G] [G]] [V.P]	[V.G] [G] [P] [V.P]	[V.G] [G] [P] [V.P]	[V.G] [G] [P] [V.P]	[V.G] [G] [P] [V.P]	[V.G] [G] [P] [V.P]	[V.G] [G] [P] [V.P]	[V.G] [G] [P] [V.P]

4.Participant 'D'	[V.G] [G] [P] [V.P]	[V.G] [G] [P] [V.P]	[V.G] [G] [P] [V.P]	[V.G] [G] [P] [V.P]	[V.G] [G] [P] [V.P]	[V.G] [G] [P] [V.P]	[V.G] [G] [P] [V.P]	[V.G] [G] [P] [V.P]
5.Part	.G] [G]] [V.P]	[V.G] [G] [P] [V.P]	[V.G] [G] [P] [V.P]	[V.G] [G] [P] [V.P]	[V.G] [G] [P] [V.P]	[V.G] [G] [P] [V.P]	[V.G] [G] [P] [V.P]	[V.G] [G] [P] [V.P]
6.Part	.G] [G]] [V.P]	[V.G] [G] [P] [V.P]	[V.G] [G] [P] [V.P]	[V.G] [G] [P] [V.P]	[V.G] [G] [P] [V.P]	[V.G] [G] [P] [V.P]	[V.G] [G] [P] [V.P]	[V.G] [G] [P] [V.P]
7.Part 'G'	.G] [G]] [V.P]	[V.G] [G] [P] [V.P]	[V.G] [G] [P] [V.P]	[V.G] [G] [P] [V.P]	[V.G] [G] [P] [V.P]	[V.G] [G] [P] [V.P]	[V.G] [G] [P] [V.P]	[V.G] [G] [P] [V.P]
8.Part 'H'	.G] [G]] [V.P]	[V.G] [G] [P] [V.P]	[V.G] [G] [P] [V.P]	[V.G] [G] [P] [V.P]	[V.G] [G] [P] [V.P]	[V.G] [G] [P] [V.P]	[V.G] [G] [P] [V.P]	[V.G] [G] [P] [V.P]
9.Part	.G] [G]] [V.P]	[V.G] [G] [P] [V.P]	[V.G] [G] [P] [V.P]	[V.G] [G] [P] [V.P]	[V.G] [G] [P] [V.P]	[V.G] [G] [P] [V.P]	[V.G] [G] [P] [V.P]	[V.G] [G] [P] [V.P]
10.Pa 'J'	.G] [G]] [V.P]	[V.G] [G] [P] [V.P]	[V.G] [G] [P] [V.P]	[V.G] [G] [P] [V.P]	[V.G] [G] [P] [V.P]	[V.G] [G] [P] [V.P]	[V.G] [G] [P] [V.P]	[V.G] [G] [P] [V.P]
11.Pa 'K'	.G] [G]] [V.P]	[V.G] [G] [P] [V.P]	[V.G] [G] [P] [V.P]	[V.G] [G] [P] [V.P]	[V.G] [G] [P] [V.P]	[V.G] [G] [P] [V.P]	[V.G] [G] [P] [V.P]	[V.G] [G] [P] [V.P]

12.Participant 'L'	[V.G] [G] [P] [V.P]	[V.G] [G] [P] [V.P]	[V.G] [G] [P] [V.P]	[V.G] [G] [P] [V.P]	[V.G] [G] [P] [V.P]	[V.G] [G] [P] [V.P]	[V.G] [G] [P] [V.P]	[V.G] [G] [P] [V.P]

Means, participant executed all measurements accurately.

eans, participant did well but couldn't execute certain measurements

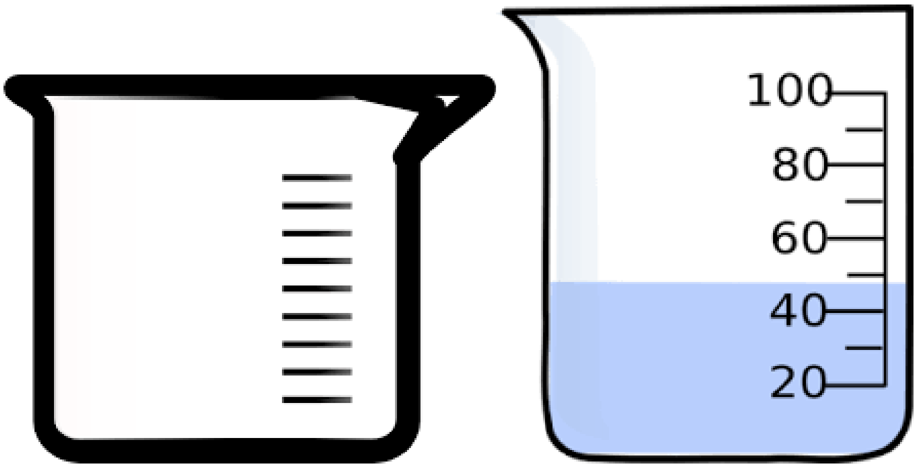
ccurately.

eans, participant couldn't execute most of the measurement accurately.

eans, participant had no idea at all.

Appendix 'D': Some instruments for measuring volume of liquid substances

Measuring cylinders



Beakers

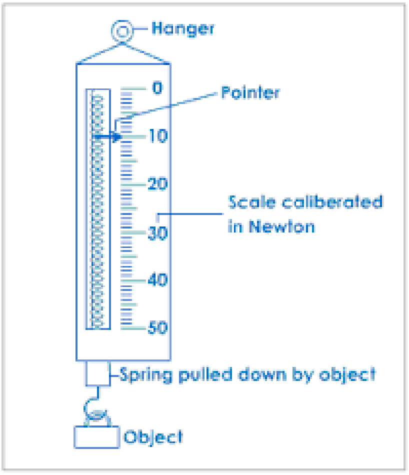
Appendix 'F': Some instruments for measuring length

Rule

Tape measure

Surveyors measuring tape

Appendix 'G': Some instruments for measuring weight



Spring balance

Digital spring balance

Dial spring balance

Appendix 'H': Some instruments for measuring mass

Electronic/digital balance

Top pan balance

Appendix 'I': **Some instruments for measuring body temperature**

Liquid-in-glass thermometer/clinical thermometer

Digital thermometer