2021-07-15

The 5e Constructivist Approach and Improvised Instructional Materials Plays an Important Role in Teaching/Learning Process on Acids and Bases Concepts of Chemistry

Mikaya, Andu

BAHIR DAR UNIVERSITY

COLLEGE OF EDUCATION AND BEHAVIOURAL SCIENCE

DEPARTMENT OF TEACHER EDUCATIONAL AND CURRICULUM STUDIES

THE 5E CONSTRUCTIVIST APPROACH AND IMPROVISED INSTRUCTIONAL MATERIALS PLAYS AN IMPORTANT ROLE IN TECHING/LEARNING PROCESS ON ACIDS AND BASES CONCEPTS OF CHEMISTRY

Presented By

Andu Mikaya Bethuel

JUNE, 2021

Bahir Dar University, Ethiopia

BAHIR DAR UNIVERSITY

COLLEGE OF EDUCATION AND BEHAVIOURAL SCIENCE

THE 5E CONSTRUCTIVIST APPROACH AND IMPROVISED INSTRUCTIONAL MATERIALS PLAYS AN IMPORTANT ROLE IN TECHING/LEARNING PROCESS ON ACIDS AND BASES CONCEPTS OF CHEMISTRY

Presented By

Andu Mikaya Bethuel

A Thesis

Submitted in partial Fulfillment of the Requirements for the Degree of Master of Education in Teaching Science Subjects (Chemistry)

Supervised By:

Associate Prof: Dr. Amera Seifu

June, 2021

Bahir Dar, Ethiopia

DECLARATION

I hereby declare that, the work in the Thesis titled ‘’The 5E constructivist approach and improvised instructional materials (IIMs) plays an important role in teaching/learning process on acids and bases concepts of chemistry’’. It was performed by me in the department of Science Education and college of Education and Behavioral Studies, under the immediate supervision of Associate Professor **DR. Amera Seifu.** The information derived from the literatures has been properly acknowledged in the text and a list of reference is provided at the end of this thesis. No any part of this thesis has been previously presented for another degree or diploma at any institution around the globe.

---------- ----------

Andu Mikaya Bethuel **Date**

INDEX NO BDU 1209572

CERTIFICATION

This Thesis titled ‘’The 5E constructivist approach and improvised instructional materials (IIMs) plays an important role in teaching/learning process on acids and bases concepts of chemistry’’ has meets the regulations governing the award of Master Degree in Science Education and Curriculum Development of Bahir Dar University and is approved for its contribution to the knowledge and literary presentation.

---------- ----------

Associate Prof Dr. Amera Seifu **Date**

Supervisor

Examiners Approval Form

This thesis has been submitted by **Andu Mikaya Bethuel,**

The thesis has been read by the Approval Board of Examine and it was found to be satisfactory regarding the English usage, format, citation, bibliographic style, consistency, and is finally ready for submission to the Division of Graduate of Education and Behavioral Science, Bahir Dar University.

Approval of the Board of Examiners

----------	**----------**
Chairperson	**Signature**
----------	**----------**
Advisor	**Signature**
----------	**----------**
Internal Examiner	**Signature**
----------	**----------**
External examiner	**Signature**

Date**----------June 2021**

DEDICATION

The Thesis is dedicated to my loving mother **Rev. Besta Robani Bethuel** and my late father **Mr. Bethuel Duku Zacharia** for their unending love, care, encourage, support and prayers always given to me for the success of their son of this programme.

ACKNOLEDGMENT

I am so grateful to numerous people who have supported my study in many way like materially, skillfully, spiritually morally and financially and without their tremendously efforts the completion of this study would not have been possible. My profound gratitude goes first to the Almighty God for his unfailing love, mercy, kindness, blessing, guidance and protection over me and my colleagues for the successful completion of this programme, and without our Lord father this would not have been made possible.

First to my supervisor Associate professor **Dr. Amera Seifu** for professional guidance and advices. I equally wish to express my sincere and profound gratitude to him who tirelessly took his time to go through the work and made necessary corrections. He is involved in the sympathetic and generous ways he helped me to finish my thesis in the satisfactorily way possible. Indeed he deserves much thanks and appreciations. May Almighty God bless **Dr. Amera Seifu**, Amen.

Secondly, my thanks goes to the Norwegian government who have sponsored me Via **NORHED** program to the completion of my dream study they are considered to receive much thanks and honors

Thirdly, to Prof **Dr. Dawit Asrat Getahun** Bahir Dar University **NORHED** project coordinator who had been kind fatherly and facilitative to me been here in Ethiopia. He too deserves much more thanks for his excellence stewardship and administration and including all my professors.

My special thanks also goes to my mother **Rev. Besta Ropani Bethuel**, late Father **Mr. Bethuel Duku Zacharia,** Brothers, **Mr. Towango Titus Bethuel, Alex Hakim Bethuel** and sisters **Mrs. Edina Sunday Bethuel, Mrs. Eva Tokosang Bethuel,** friends, clan members and class mates too numerous to be mentioned. May God bless and protect you all. Amen.

Abstract

The main purpose of this study was to investigate the effects of improvised Instructional materials (IIMs) and 5E constructivist approach the teaching of acids and bases concept of chemistry. Quasi experimental research design was employed. Two grade (primary) classes were selected experimental (N=28) and control (N=34) groups. The students in the experimental group were instructed with the IIMs and 5E instructional model of constructivist approach, and students in control groups were instructed with Traditional teaching instructional for two weeks. Acids and bases were concepts tested. Classroom observation and informal classroom assessment were used as data collection instruments. Pre-test and post-test were analyzed quantitatively (comparative, descriptive statistics and independent sample t-test) while classroom observation and informal classroom assessment were analyzed qualitatively. There was a statistical significant mean difference between control and experimental group students at $p<0.05$. The post-test comparison of the students in experimental group demonstrated changes in conceptual understanding of the acids and bases concepts compared to the control group. Similarly, the post informal classroom assessment comparison of students in experimental group showed a higher explaining and reasoning ability of the concepts compared to the control group. Based on the finding, the researcher suggested that science teacher should use IIMs and 5E learning cycle model of constructivist approach in chemistry learning/teaching process. From the results, it is possible to conclude that the IIMs and 5E instructional model of constructivist approach were more effective than traditional teaching instructional in students' conceptual understanding

Key words: IIMS, acids and bases concepts of chemistry, 5E Constructivist Instructional approach and poor performance.

Table of Contents

LIST OF FIGURES

LIST OF TABLES

ABBREVIATION ACRONYMS

This part is to explain the meaning of some adopted acronyms and abbreviations that are contained in this thesis and they are as follows:

MoEST: Ministry of Education Science and Technology

IIMs: Improvised Instructional Materials

CG: Class Eight Control group

EG: Class Eight Experimental

SPAT: Pupils Science achievement Test

PPMCC: Pearson Product Moment Correlation Co-efficient

SPSS: Statistical Package social Science

NGOs: Non-Governmental Organizations

PTA: Parents Teachers Association

CHAPTER ONE

1. Introduction

This chapter contained the background to the study, statement of the problem, research questions, and research objectives, then significant of the study, Delimitations, context and scope, operational terms.

1.1. Background of the study

Chemistry is a science subject that is offer in south Sudan secondary school curriculum. According to Kauffwan and Szmant, (1987) as stated in (Mwangi, 2016), chemistry is characterized as the most utilitarian of all the experimental science. For example, in South Sudan a good secondary school pass or grade in chemistry is a pre-requisite for joining medical, science education, applied science, Engineering, and agricultural professional courses.

Poor performance in the Chemistry subject means, science education and health-related professionals that could subsequently lead to low health care provision, food security and under-development in the country. Science deals with observation, testing of observed facts, touching, hearing and seeing. Learning materials should therefore be presented in a manner so as to provide students with the opportunity to become actively involved intellectually through observing, hearing, seeing and touching. Teacher made resource instructional materials refer to improvisation. (Omiko 2007) stated that improvisation in austere period is very fundamental and crucial because it reasonable reduces cost of procuring new and imported materials.

Teaching and learning materials are those materials that enhance practical work and demonstration in the classroom situation by pupils and teaching (Obenem, 2000). Such teaching and learning aids are the improvised instructional materials. Instructional materials are print and non-print items that are used to impart information to the pupils in the educational process particularly in teaching and learning sciences.

Improvised Instructional materials IIMS include important items such as science kits, textbooks, magazines, newspapers, pictures, recording videos, real objects, models and many more. They can also be referred to as relevant and cheaply selected tools and equipment that are usually incorporated in the teaching and learning in order to boost or enhance effective teaching and

learning activities in the classroom or any other environment where formal education system take place. National Teachers Institute (NTI, 2007).

Instructional materials play a very important role in the teaching and learning process. It enhances the retention of level of pupils. At this era, that education has become popular and an obligation, oral teaching cannot be the key to successful pedagogy; therefore, a teacher needs to use Improvised instructional materials to make the teaching and learning process interesting and understandable by the science learners which can help Biology and other science students to carry out experimental and learning activities, Ahmed, A. M. (2008). There is a need to emphasis and focus on the use and important of Improvised instructional materials in any teaching and learning environment that cannot be underestimated. For improved teaching/learning to take place, the teacher has to make use of Improvised instructional materials and 5E constructivist approach that would enable him to teach effectively.

High-quality schools combine classroom science teaching with laboratory experiments to ensure that their Students grasp every Science concept thoroughly. It is believed that laboratory teaching and experiment were conducted to help encourage deep understanding in children. Students in class are able to retain the knowledge for longer period when experiments are performed in their presence (Bajaj, 2017).

The 5E learning cycle is a constructivist approach which improves students' participation in the learning process by satisfying expectations of students. It consists of active research skills and activities that are necessary for knowledge and comprehension (Ergin, 2006). The 5E model targets at the discovery and the association with previous knowledge of the new concept by students. It motivates students to be included into a topic by several phases of learning, to explore a subject, to be given a definition for their experiences, to obtain more detailed information about their learning and evaluate it (Wilder & Shuttleworth, 2005). 5E learning cycle is one of the complete constructivist models in the cases of research based learning or brain-storming which are used in the classroom (Campbell, 2000).

Students think creative and complex for overcoming problem and difficulties and a result, they have to think in an integrative manner in order to unify their thoughts. This situation can only occur when students have higher order thinking skills. These skills are called also critical thinking skills. Critical thinking like the concept of education is regarded as a type of critical analysis has been described as disciplined intellectual criticism that combines research,

knowledge of history context and balanced judgment. It is the ability to think logically and analytically, Encarta (2009).

Students learn the working principles in the improvised instructional materials and 5E constructivist approach they make or help teachers to make; it create and develops technology awareness in the pupils. Equipment and other instructional materials extensively determine the method a teacher uses in teaching. The method adopted could be demonstrated, experimental, discussion and many more (Effiog, Ekpo, & Iriri, 2015).

Strategies of Improvisation

1. **Trust:** for a group of science teachers to be successful and productive in their duty, the members of the group referred to as ‘’players’’ must trust one another.
2. **Acceptance:** this is the Golden rule’’ of improvisation (Gessell, 1997). Teachers must be willing to accept a new idea to explore its possibilities. Teachers must say yes, accept the offer, build on it, contribute and discover new ideas. It is this process the new power of collaboration. The brainstorming that occurs can lead to innovative solutions (Koppett, 2001).
3. **Attentive listening:** Science teachers must be aware of the partners with whom they are co-creating to increase their understanding of each other and to be able to communicate effectively.
4. **Spontaneity:** this allows teachers to initiate words and actions, building trust with other teachers. This enhances co-creation in the moment, without the opportunity to revise (Keefe, 2002).
5. **Nonverbal communication:** this involves the use of facial expressions and body language to help communicate attitude, character, and trust worthiness.
6. **Warm ups:** they are strategies that provide opportunity to develop trust and safe environments, where the teachers can feel free to explore the world of improvisation. These activities focus on changing teachers into an improvisational mode to allow them to improvise verbally and physically (Koppett, 2001).

The chemistry teachers ought to know the procedures for constructing alternative instructional materials with which they can help their students to visualize whatever the topic. In the vision of the above-mentioned benefits of improvisation, the researcher has investigated the effect of improvised instructional materials on the teaching of science concepts on pupil’s

academic achievement. For that reason, this study has a very important need in teaching and learning of acids and base topic.

1.2. Statement of the Problem

According to ministry of Education Science and technology (MoEST) of South Sudan in the recent times has focused on improving the quality of teaching and learning of science to reverse the trend of poor performance in the science subjects i.e. Biology, Chemistry and Physics. It indicates that the understanding and application of scientific concepts of students in science are poor, hence, affecting their performance in the science subject particularly in acids and bases topic. It had also been observed that students usually fail in examination due to improper method of teaching methods and lack of essential teaching aids for appropriate instructional delivery (Afolabi, 2013).

The topic of acids and bases has posed many problems to students of various backgrounds. In south Sudan, science teachers teaches acids and bases topic theoretically for two periods. In each day, only 35 minutes per period. Making it hard for science teachers in south Sudan should be able interpret it clearly to the students to understand the concepts as acids and bases are commonly used in our daily life i.e. in foods and drinks.

According to (Chiu, 2004, 2007; Demircioglu, Ayas & Demircioglu, 2005; Huang,2004; Kala, Yaman & Ayas,2013; Sheppard, 2006; Drechsler & Van Driel, 2008,2009) they state that even until recently, several studies have been documented that refer to alternative conceptions about acids and bases that are held by students and teachers alike and concepts continue to be a problem for students at all levels of schooling as indicated by several past studies. As studies involving student`s difficulties in understanding acid- base concepts date back several decades, in this paper I have decided to refer to studies that show the concepts of acids and bases and reactions.

Primary school teachers in general and science teachers in particular, are expected to effectively utilize instructional materials to facilitate the teaching-learning process for the attainment of their intended objectives (Awobodu, 2002). The performance of the Students in science subjects had been deteriorating in the recent years from 2009 up today, World Bank book report 2009, (pg. 62, 85). The republic of south Sudan is likely to produce weaker results since most of the country's schools teachers are not aware of the south Sudan education objective.

Most students in South Sudan passed their examinations with malpractices and without the science concepts.

The above studies and others stipulated that, the availability and effective use of instructional materials and 5E constructivist approach by the science teachers during teaching/learning process will results in brilliant academic performance and achievement of the lesson objectives. Hence, the researcher has brought to light the impact of improvised instructional materials IIMS and 5E constructivist approach in teaching/learning of science in upper primary schools in south Sudan.

1.3. Conceptual Frame work

The conceptual framework was the researcher understanding of how the particular variable in the study connect with each other. The conceptual framework of this study showed that the relationships between the variables. The dependent variables were the IIMs, 5E constructivist approach and traditional teaching instruction approach and affected by independent variable that is the students' conceptual understanding in acids and bases concepts of chemistry. This study used 5E learning cycle model of constructivist approach in Chemistry classroom with the teaching acids and bases concepts to improve students' conceptual understanding which is the basic abilities in chemistry learning.

This study too expected that IIMs and 5Econstructivist approach have significant values in improving students' conceptual understanding than traditional instructional method. In traditional instructional approach, all the concepts is described by the teacher and not easy for the learners to understand the concepts of acids and bases. According to Bybee et al., (2006) 5E instructional model of constructivist approach is a hand-on and mind-on teaching approach through the five phases.

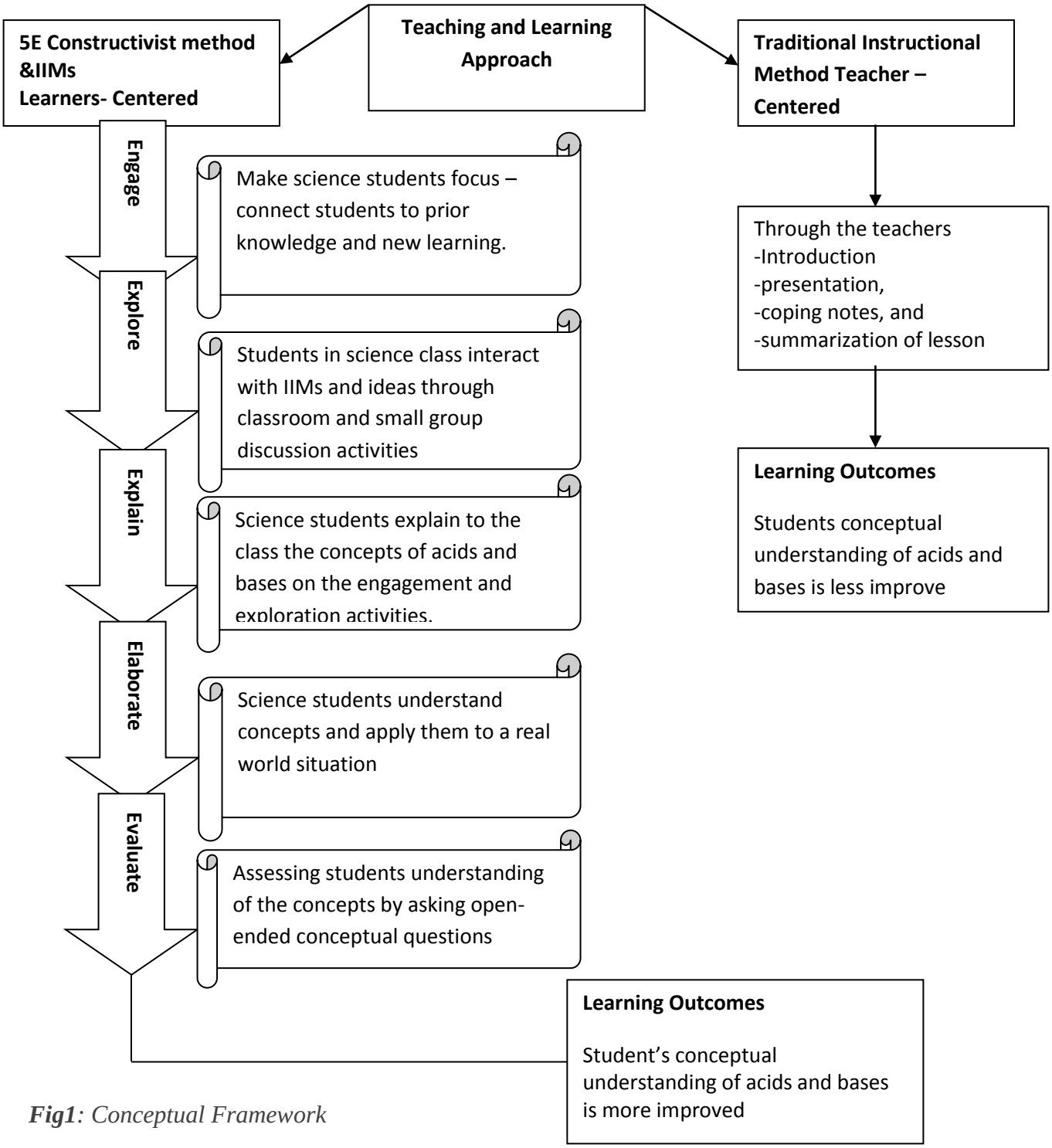

***Fig1**: Conceptual Framework*

1.4. Objectives of the study

This study aimed at investigating the effects of 5E constructivist approach and improvised Instructional materials on the teaching of acids and bases concepts of chemistry.

Specific Objectives of this study are;

1. Observe the values of improvised instructional materials (IIMS) on primary eight-science pupils' academic achievement and performance.
2. To inspect the Science performance of Students through the use of 5E constructivist approach improvised instructional materials.
3. To examine the effects of 5E constructivist approach in teaching/learning of acids and Bases concepts of chemistry.

Research Questions

1) How helpful are improvised instructional materials & 5E constructivist approach on teaching/learning acids and bases toward learners' performance?
2) What is learners' observation on use 5E constructivist approach and improvised instructional materials?

Hypothesis

There is statistical significant difference in students' conceptual understanding of chemistry concepts in acids and bases between experimental and control group students.

Significance of the study

As a science teacher from un-developing country like south Sudan, teaching science in particularly acids and bases topic is difficult, since it is taught from a more theoretical standpoint and lacks the practicality of a science concept. The need to undertake this study is to determine the effects of improvised instructional material in constructing deep understanding of acids and bases concepts in upper primary school. The implications from this finding may be of great benefit to the Science teachers if IIMS are properly utilized. This Study attributed to the lack of resources in schools. The study made appropriate improvised instructional materials in place of

standardized instructional materials on teaching/learning of acids and bases. In addition, the study helped to reveal the sensitivity of science teachers and students on the use of improvised instructional material. Furthermore, it helped to know the effectiveness of improvised instructional materials and 5E constructivist approach in teaching Chemistry in schools of south Sudan.

The findings from this study provided relevant information as regards to the skills of the producing and utilizing locally made instructional materials to the classroom science teachers for effective teaching-learning process in science. The research is also documented evidence of what is available and the deficiencies, at present in terms of teaching materials in most of primary schools. Also other Findings from this research are very significant to government as it helped them to identify where, when and how to assist and motivate science teachers in developing and using of the improvisation of instructional materials in teaching of science. In addition, the curriculum planners benefited from this study as the study enabled them to make provisions for science teachers in the production of instructional materials in science curriculum.

The research work helped students to appreciate the importance of locally made instructional materials in learning science. With such it has motivated them to have interest and increased their performance in science. Parents whose children are in upper primary school benefited from this study because they will be enhanced on their great impart towards effective science concepts acknowledgement by their children awards. Similarly, they benefited because their awards when they are effectively taught through improvisation of instructional materials, this act of improvisation made their awards prosper and succeed in their study. In that way, it reduces financial wastage on their parents. Similarly, the fellow researchers in related topics saw this study as a source of materials that can be used for the study. More so, the study helped parents to draw the attention of the school authority to the needs for proper improvisation of instructional materials in primary and secondary schools. Finally, the study made recommendations on the types of local instructional materials that are appropriate for science teachers to utilize effectively in the teaching /learning process in a topic of acids and bases.

Context and scope of the study

This study focused on the basic level of acids and bases in primary eight classes in the school curriculum of south Sudan and was carried only in Gudele East one Primary school, Juba city. In the South Sudan educational system, acids and bases topic is taught in primary eight with very few subtopics integrated with other sciences and also found in senior one and senior four with an addition of salts. From primary one to primary seven the acids and bases concepts are not showed in the science content. It became difficult to learners to understanding the topic when introduced to. This unit at primary eight class comprise of meaning of acid and bases, properties of acids and bases, uses of acids and bases, examples of weak and strong acids and bases, universal indicator, it is the area of science in upper primary school which was given less value in comparison to other topics. From as early as several decades ago the topic on acids and bases has been reported to be difficult for high school students (Burns,1982) who have as a result held several alternative conceptions about acids and bases (Artdej et al,. 2010; Cros et al,. Hand & Treagust,1991; Nakhleh & Krajick, 1993).

1.9. Concepts of Acids and Bases

1.9.1. Elementary Content of Acids

The term acid was first used in the seventeenth century; it comes from the Latin ac; meaning /sharp ‘’, as in acetum, vinegar. Acids have long been recognized as a distinctive class of compounds whose aqueous solutions exhibit the following properties: A characteristic sour taste; Ability to change the color of litmus paper from blue to red; React with certain metals to produce gaseous H_2; React with bases to form a salt and water. Acids have many uses. For example, phosphoric acid is used to make gasoline additives and carbonated beverages. The textile industry uses oxalic acid (found in rhubarb and spinach) to bleach cloth, and glass is etched by hydrofluoric acid. Dyes and many other chemicals are made with sulfuric acid and nitric acid, and corn syrup, which is added to a variety of foods, is processed with hydrochloric acid.

1.9.2. Elementary Content of Bases

The name base has long been associated with a class of compounds whose aqueous solutions are characterized by: a better taste, ‘’a soapy” feeling when applied to the skin, ability to restore the original blue color of litmus that has been turned red by acids and Ability to react with acids to form salts. The word ‘’alkali” is synonymous with base. It is of Arabic origin, but the root word comes from the same Latin Kalium (potash) that is the origin of the symbol for potassium; wood ashes have been the traditional source of the strong base KOH since ancient times. Just as an acid is a substance that liberates hydrogen ions into solution, a base yields hydroxide ions when dissolved in water:

1.9.3. Elementary Reaction of Acids and Bases

Acids and bases react with one another to yield two products: water, and an ionic compound known as a salt. This kind of reaction is called a neutralization reaction. These reactions are both exothermic; although they involve different acids and bases, it had been determined experimentally that they all liberate the same amount of heat (57.7kJ) per mole of H+ neutralized. This implies that all neutralization reactions are really the one net reaction $H^-_{(aq)}+OH^-_{(aq)} \text{-}\rightarrow H_20_{(I)}$. The “salt” that is produced in a neutralization reaction consists simply of the anion and cation that were already present. The salt can be recovered as a solid by evaporating the water.

Improvised Instructional Materials IIMS

Improvised instructional materials are teaching materials designed and produced from the available local materials in order to promote effective teaching and learning in school. They are materials that are used in the absence of the original or idea objects to bring about the same learning effect that the standard materials would have brought (Ahmed 2008.) Ndirangu et al (2003) investigated the effective use of improvised materials designed by science teachers during their teaching practice. This study presented evidence that improvised teaching materials designed by science teachers during practice had a great influence in their teaching of acids and base topic. these improvised instructional materials are found to be less cost , durable and could last a longer time to enhance effective teaching and learning of science in school that are unable

afford expensive standardized instructional materials. Science teachers should be encouraged to make their own teaching resources from the locally available materials to teach science.

Theoretical framework of the study

Gagne's cognitive theory of IIMS

Gagne (1977) maintains that new learning occurs through the combing of previously acquired and learned entities as well as upon their potentials for transfer (Oladele 1998). Because of that, the rate of cognitive development does not depend on innate factors of maturational readiness only, but also on the mastery of simpler pre-requisite resources or material around us. Gagne proposed five different kinds of learning and proceeded further to delineate how instructional may be used to facilitate the acquisition of each. Implication of the Gagne's theory of the instructional to the study is that; Teachers must always state their learning objectives in clear behavioral term. This helps the science teachers to be focused and it guides him/her to how to know the right resources in the kitchen to use in his/her teaching/learning process. When this is done, it may bring meaningful learning outcomes. Learning units or tasks must be properly analyzed to identify their relevant components. When the relevant components are identified and arranged in a hierarchical form and relevant improvised instructional materials selected, it may bring about high academic performance of the students. The arrangement of the relevant should be in a manner that would ensure easy comprehension, effective and meaningful learning. This arrangement when back up with instructional materials that are drafted from the learner's environment may increase their academic performance. Gagne's theory of instruction can be of remarkable importance to the teacher teaching science. The objectives of the lesson must be stated in clear and behavioral form to guide the teacher on what to teach and in selecting materials for improvisation. Materials to be presented to learners are needed to be broken down into relevant components and teaching is to be in a hierarchical order.

A framework For Learning

Traditional, college teachers have assumed that students learn through lectures, assigned readings, problem sets, and lab work. Yet we have all been frustrated by frequent failure of our students to learn basic concepts of science. Because of the pace and large enrollment of many

students in class, students are often not able to discuss and reflect on difficult materials. Evident is mounting that these traditional methods are less effective than we once thought in helping our learners to develop an understanding of the science concepts that we are teaching (Pearsall, 1992). People use their experiences to build mental frameworks that help them make sense of the world. Then, when they encounter a strange event or phenomenon, they use these mental frameworks to interpret the information, to make generalizations or to make predictions. The familiar, Ah ha! Now I get it!'' reflects students' active wrestling with a new idea and successful adaptation or modification of the mental frameworks. Students, then, are not like blank slates 0r sponges ready to absorb knowledge. Nor is student performance simply a result of innate ability or rich experiences, although both affect learning. Rather, experience and knowledge already acquired affect how students interpret and apply information in new situations (Brooks and Brooks, 1993; Glynn and Duit, 1995).

Learning Approaches

Approaches to and attitudes toward learning vary substantially (Craik and Lockhart, 1972; Withkin and Goodenough, 1981; Koballa, 1995) a student's primary learning style determine how he or she perceives, interacts with, and responds to the learning environment (Claxton and Murrell, 1987; National center for improving Science Education, 1991). Thus, teaching methods effective for some students may be ineffective for others. Some students may prefer to have information presented both verbally and graphically, or presented sequentially or hierarchically. Many students learn best through hands-on or personal experience. Some students' response immediately to questions you pose in the class while others reflect on possible answers before venturing a response. Some students seem to learn effectively from lectures, while others prefer reading the same materials (Tobias, 1992). Learning is enhanced when we create a classroom environment that provides students with opportunities to learn in several ways. We might, for example, use IIMS to enhance a teaching. Similarly, science learning must be an interactive process in which students become engaged with scientific phenomena and debate with both peers and instructors in order to develop a full understanding of related phenomena and underlying concepts. When we teach science only as a set of truth, we run the risk of subverts our students' attempts to grapple with problems and make new experience meaningful. We deny them the opportunities to engage in the scientific process. While science

understanding comes through an individual's personal efforts at making sense of the world around him or her, not all knowledge can come through individual discovery. Indeed, a good deal of our science knowledge must come from texts, and original resources. How might we as teachers, make better use of traditional formats to help your students gain knowledge and understanding? The sections of the study provide a sequence of teaching and learning materials that incorporates with 5E Constructivist Approach.

5E constructivist approach as a method of teaching acids and bases concepts of chemistry

Classroom environment have to be created where students are involved in scientific process where they investigate various phenomena through observation, measurement, classification, experimentation, making senses of data and drawing conclusions. This type of atmosphere involves students in similar activities engage in and creates environment for effective and meaningful learning. Students should learn to solve problems, think critically and make decisions within a context of a few broad unifying concepts where they learn the connections between concepts/principles and are able to apply their understanding to new situations. This is contrast to covering large amount of instructional materials where students can learn facts or skills in isolation.

Learning theory assert that for understanding to occur multiple representations of ideas need to be utilized (Blumenfeld, Marx, Patrick, Krajcik and soloway, 1998). When students make connection between these representations, in-depth and integrated learning occurred, allowing students to apply their knowledge to new situations. In an inquiry, project based classroom students investigate questions rooted in students' real world experiences (Krajcik, J.S. et al, 2002; Novak, & Gleason, 2001). These real- world experiences can be framed in meaningful and important questions such as How an acid is important in human body?'' or where do acid and bases found?'' or Why should I use acids and bases in our daily food?''Because they are meaningful and anchored in real world experiences these driving questions, help to contextualize learning for students. These questions present opportunities to draw students in and direct them toward learning that has relevancy to their lives. The driving questions contain within them important science concepts. In the process of investigating these and other sub-questions, students develop understanding of science concepts and science process (Schneider, Krajcik, marx & Soloway, 2001). Students are at the axis of knowledge building

through their active inquiry into the question. They become a community of learners who are collaborating to answer their own questions. The teacher carefully and masterfully provides scaffolds throughout the curriculum to move students from novices towards an expertise in understanding and problem solving (Krajcik et al, 2002; Reiser, Tabak, Sandoval, Smith, Steinmuller, & Leone, A, 2001). In doing so, the teacher's help building environment in which students can create a community where learning is recurrently pushed to the next level.

In addition, those technologies can play a powerful role in enhancing this community by increasing both students and teachers motivation by actively engaging students in the learning process. Dwyer (1994) found that using technology transform the way in which teachers taught. Teachers transitioned from a teacher- centered classroom, mainly utilizing the lecture method of teaching to a student- centered classroom where the teacher role was one of a collaborator rather than an expert''. With learning technology as a catalyst these classrooms where transposed from teachers as the provider of the information to one in which teachers assist students in developing understanding through active engagement with the phenomena by asking '' what if questions. The results are more inquiry-based learning environments that align with the National Standard.

5E Constructivist approach learning activities

Inquiry learning activities were considered to be effective in teaching chemistry and have been highly advocated in the last few decades (Sanger, 2009). These types of activities posses more advantage in excess of traditional instructional approach. These advantages includes the encouragement of students to practice using learning resources and working in the group to enhance their conceptual understanding and the opportunities for teachers to play roles as facilitators who motivate the challenge students to carry out the activities through a science inquiry process (Deters, 2005).

The 5E learning cycle has been proven to be of the most effective inquiry learning in chemistry (Bybee et al, 2006). It involves students throughout the following steps: 1) Students are engaged in inquiry questions (2) students explore answers to the questions by planning, designing and carrying out their experiments, and recording the experiment data. (3) Students make explanations from the experimental data to answer the questions (4) students elaborate, extend or apply their findings in a new context finally (5) students evaluate their experimental processes

and results in a variety of ways. This learning cycles is effective to support students to notice and correct their alternative conceptions (Balci et al, 2006; Bybee et al, 2006). Theories of instruction and learning reviewed provide the necessary framework, on which part of this study that has to do with academic achievement of the upper primary learners.

Engaging students

Scientific embark upon a problem because they have had their curiosity piqued by a strange event or a puzzling question or some other occurrence that cause them to wonder and resolve the apparent discrepancy between what they now and what they are experiencing. Similarly, instructors can help students become active learners by motivating them with open-ended questions, puzzling, and paradoxes. What happens when….? Why does that happen? But how can that be, when we know that…? Fill integration of new knowledge is enhanced by time to reflect. Reflection is especially beneficial immediately following the presentation of new, challenging material. One effective method (Rown, 1974) is to provide, after ten minutes of lecturing, short periods (a minute or two) for students to think. The necessary structure can be provided by a pertinent question. An alternative to asking questions is to as students to summarize some important ideas from a previous discussion or the reading assignment. This focuses their attention and gives the teacher and opportunity to assess their level of understanding. Because students assessing for prior knowledge is an essential component of teaching for active learning. Students most likely to change beliefs if they develop dissatisfaction with those beliefs and recognize possible alternatives as they prepare themselves to adopt a new more acceptable view (Anderson and Roth, 1992' Minstrell, 1989; posner et al. 1982; West and Pines, 1985).

Establishing a Context for Exploration

Just as a scientific explores various possibilities for resolving differences between the current view of the subject and new and contradictory information, so too does a teacher have to provide students with a chance to explore their ideas. This could be laboratory experiment that helps students take the first step in finding answers to the questions posed in the class. Students should talk to each other and their teacher in order to articulate what they have experienced during these explorations. Talking helps students work through their preliminary thoughts about concepts. Some structures and guideline can help students find a forum to discuss and clarify

their thinking. A teacher might as the students to form small groups in or order to work on problem and discuss major concepts, for example. Those which relate to the lab experiment.

Proposing Explanations

Having interested your learners in describing and exploring some phenomena, you might provide opportunities for them to attempt explanation and synthesis. Again, teachers might use leading questions; can anyone suggest in your own words, an explanation for question A? Does the idea also explain Y? Can anyone think of a counter example? As teachers, we know that one of the best ways to learn something is to explain it to someone else. You can give your students this experience by asking them to write a short summary paper addressed to non- scientist in whom they attempt to clarify difficult concepts like acids and bases. This exercise helps students understand new concepts as they connect their current knowledge with the recently learned information. Explanatory writing requires students to organize their thoughts as they plan how to explain something to a peer who is not familiar with the concepts. As Meyers and Jones (1993) recognize, ‘’…. Writing can be a powerful prod to the explanation, modification and creation of mental structures.’’

Reading and Writing for Understanding

Students can solidify their understanding of science concept by applying their explanation in a new setting. This process helps students create new mental frameworks that lead to deeper understanding. Opportunities for reading and reflection also help students incorporate new concepts. We know from studies of reading with secondary students that giving specific study questions before students start reading increase the likelihood that student will recall the information they read (Winograd and Newell, 1984). Thus, by giving explicit instructions for an assigned reading, you can increase what students comprehended in the reading. There are a variety of way to encourage students reflect on their learning by writing about it in their notes books. Students needs to write every day, but frequently writing in which students reflect critically on a text assignment and integrate these components to help them make sense of complex conceptual ideas of science (Bonwell and Eison, 1991). In numerous ways, this activity is similarly to keeping a content notebook, in which the students summarized and reflect critically on one or more completed experiments and begin to make connections between their outcomes.

Student's alternative conceptions in acids and bases concepts of chemistry

One of the barriers to new learning is the misconceptions that students may have about the instructional topic. Research studies showed that students' prior experiences, back group, environment, world view affect their interpretation of observations, concepts etc. as a result, students may come to the classroom with some misconceptions toward the instructional subjects to be taught. But, traditional textbooks and instructional strategies are not helpful in moving these misconceptions because simply presenting materials, giving out problems and accepting answer back is not an effective way of forming students current thinking, you may able to strategize ways for students to first question those pre-instructional conceptions before introducing new ideas. In science education, there are extensive literatures about the incorrect scientific understandings of students which focus on the identification of them, classification of them and evaluation of the instructional strategies to change them.

This process of changing the students existing conception (i.e. beliefs, ideas, or way of thinking) of student is called as conceptual change. In conceptual change, existing conceptions become a conceptual framework that students use to solve problems, explain phenomena, and function in their real world. The first and most important step in teaching for conceptual change is to make the students aware of their own ideas about the topic or the phenomena under the study. As science students become an aware of their own conceptions through presentation to others and by evaluation of those of their peers, they become dissatisfied with their own ideas; conceptual conflict begins to build. By recognizing the inadequacy of their conceptions, students become more open to changing them. After dissatisfaction with their existing conceptions, requirements for conceptual changes are that the new conception be intelligible, plausible and fruitful (Posnor, Strike, Hewson, & Gertzog, 1982). Conceptual misunderstandings arise when students are taught scientific information in a way that does not provoke them to confront paradoxes and conflicts resulting from their own preconceived notions and nonscientific beliefs. To deal with their confusion, students construct faulty models that usually are so weak that students themselves are insecure about the concepts. Here are some students alternative conceptions always arise in a classroom while teaching acid and bases lesson;

Helping students Overcome their misconceptions

It is useful to review and think about possible misconceptions before teaching a class in which new materials is introduced like IIMs. Use questions and discussion to probe for additional misconceptions. Students will often surprise you with the variety of their preconceptions, so be careful to listen closely to their answers and explanations and by revisiting difficult or misunderstood concepts after a few days or weeks. Misconceptions are often deeply held, largely unexplained, and sometimes strongly defended to be effective, a science teacher should not underestimate the importance and the persistence of these barriers to true understanding. Confronting them is the difficult for students and teachers. Some misconceptions can be uncovered by asking students to sketch or describe some object or phenomenon. For example, one might as students to sketch an atom before doing so on the board. By asking them to draw their own model first and then asking some students to share their answers with the class, a teacher can identify preexisting models and use them to show the new models

Breaking down of Students Alternative conceptions

Recent research on student's conceptual misunderstanding of natural phenomena indicates that new concepts cannot be learned if alternative models that explain a phenomenon already exist in the learner's mind. Although scientists commonly view such erroneous models with respect, they are often preferred by learners because they seem more reasonable and perhaps are more useful for the learners purpose (Mayer, 1987). These beliefs can persist as lingering suspicions in students mind and can hinder further learning (McDermoth, 1991). Before accepting the concepts held to be correct by the scientific community, the students must deal with their own beliefs along with their associated paradoxes and limitations and then attempt to reconstruct the knowledge necessary to understand the scientific model being presented. This process requires that science teachers:

- Identify students' misconceptions
- Provide a forum for students to confront their misconceptions.
- Help students reconstruct and internalize their knowledge, based on scientific models.

Before misconceptions can be corrected, they need to be identified; a forum for students to tackle their misunderstanding has to be given and the teachers should help their students

reconstructing their knowledge base on scientific methods. Many Researchers and science teachers have compiled lists of commonly encountered misconceptions. A numbers of professional societies have developed conceptual test which allow you to identify students misconceptions; one of the way to promote conceptual changes and removing misconceptions is using conceptual change texts which are prepared to point out students' misconceptions and their weakness of explaining or answering a problem with giving examples. Analogy is another effective method to overcome misconceptions. The use of analogical relation between the known and un-known can help the students learn new information and discard or modify misconceptions. Analogies make the new materials intelligible to students by comparing it to the materials that are already familiar to them. The present study examined both using analogy and conceptual change text to overcome the students' preconceptions about acids and bases. Stavy (1991) stated that using analogy to overcome misconceptions about conversation of matter'' can be an effective tool in teaching. Clement (1993) reported that using bridging analogies to deal with students' preconceptions in physics can play a very important role in science instruction.

Delimitation of the study

This study was confined in its scope to Gudele East One primary school of Juba City. The researcher selected this school so as to make the study manageable in terms of distant, insecurity problem, less coverage in syllabus book. The study also delimited only to investigate the effectiveness of improvised instructional materials IIMs in constructing deep understanding of acids and bases concepts on upper primary students of grade eight as a population of the study.

Operational Terms

South Sudan education structure system; Education in south Sudan is modeled after the educational system of the Republic of Sudan. Primary consist of eight years (primary one to primary four is a lower primary and from primary five to eight are upper primary schools), followed by four years of secondary school and ten four to five years University instruction; 8 + 4 + 4/5 system, in place since 1990. The primary language of all level is English, as compared to the Republic of Sudan, where the language of instruction is Arabic, world bank report (2012). There are a severe shortage of English teachers and English speaking teachers in the scientific

and technical fields.

Chemistry: Chemistry is the study of matter, energy and the interaction between them. Science which is chemistry is everywhere in the world around you! It is in the food you eat, clothes you wear, water you drink medicines, air cleaners, you name it (Helmenstine, 2011). Chemistry sometimes is called the ‘’central science’’ because it connect physical science that includes Chemistry, with the life science and applied science such as Medicine and Engineering (en. Wikipedia.org 2019).

Improvised instructional materials (IIMs): improvised instructional materials are teaching/learning materials designed and produced from available local materials from school garden from homes in order to promote effective teaching and learning of science in schools. They are materials that are used in the absence of the original or ideal objects to bring about the same learning effect that the standard materials would have brought (Ahmed 2008).

Acids: An acids is a molecule or solution that contains a lot of hydrogen ions (H+). Acids like to donate hydrogen to other compounds. Acids usually taste sour, like lemon juice or vinegar.

HNO_3, HCL, H_2SO_4, CH_3COOH, HBr

Bases: Bases are molecules or solutions that are low in hydrogen ions. They base to grab hydrogen off of other compounds. Bases usually feel slippery, like soap.

NH_3, $CaCO_3$, NaOH, H_2O.

5E constructivist approach: it is a design in constructivist learning approach or it is constructivist instructional strategy that process through five phases these are; Engage, Explore, Explain, Elaborate and Evaluate, each phase cover hand-on and mind-on activities.

Constructivist teaching approach: constructivist teaching is based on the belief that learning occurs as learners are actively involved in a process of meaning and knowledge construction as opposed to passively receiving information

Summary

This chapter of the study presents the followings; Background of the study, statement of the problem, research Objectives, research questions, hypotheses of the study, significance of the study, delimitation of the study, context and scope of the study, operational terms, Concepts of acids and bases, Improvised Instructional materials, theoretical framework of the study; which it

described, the Gagne Cognitive theory of IIMs, A framework for Learning, Approach to learning, conceptual framework, 5E constructivist approach as a method of teaching acids and bases concepts and Students' alternative conceptions in acids and bases.

CHAPTER TWO

2. Review of Related Literatures

2.1. Introduction

This chapter presents the relevance literature reviews for this study. The first presents theoretical literature. This is focus on two theories; instructional materials (IIMS) and socio-cultural theory of teaching, learning and development. The second part presents empirical literature that revolves around the stated objectives developed in chapter one. These include; the extent to which improvised instructional materials affect students' performance and understanding. The last part presents conceptual framework that was developed by stuffle-bean comprised of context, input, process and output.

2.2. Theoretical Framework

2.2.1. Instructional Material Theories

Instructional materials theories assume that there is a direct link between the materials that the teachers use, and the students learning outcomes. These outcomes include the higher abilities to learn, quality strategies to learn and perform classroom activities and positive attitude towards learning. Further, these theories assume that instructional materials have the capacity to develop into students the higher order of intellectual skills as they illustrate clearly, step by step how to follow the rules/principals and elaborate on the concepts, all of which have positive impact on solving new problems by analyzing the situation and formulating a plan (Gagne et al. 2005). According to Gagne et al, instructional materials can be used to develop higher learning abilities to the learners through self-teaching or guided learning. This implies that the improvised instructional materials mainly comprise ''eliciting performance'' and ''providing feedback on performance correctness'' in addition to ''providing learning guidance'' for guided discovery learning.

Many of the Gagne's ideas have a broad implication for secondary teachers in the community secondary and upper primary schools in Juba city. Many of these ideas have capacity building under-stones with themes of the students' acquisition of critical thinking and problem solving skills. However, the theory does not relate to whether or not students can thin critical in what aspects or how they can solve a particular problem by themselves.

There is a belief that the purpose that the improvised instructional materials or technology in Education is to enlarge students' imagination and to encourage them to solve

problems in their lives. Similar ideas are held by Lev Vygotsy, a Russian Psychologist who held a view that tool and signs, which are in a form of instructional materials, have the capacity to develop in students' higher level of thinking which is important in problem- solving activities. Equally, since they are considered to be domain-specific, the ways instructional materials can start cognitive development is yet to be studied with respect to classroom teaching. Thus, this study widens these views.

2.2.2. Socio-cultural Theory of Teaching, Learning and Development

Socio-cultural theory of teaching, learning and development is the second theory that framed this study. Largely inspired by the shaping works of Lev Vygotsy, this theory assumes that human minds do not develop by virtue of some predetermined cognitive structures that unfold as one matures. Rather, this theory explains that human's minds develop as a result of constant interactions with materials world. According to Vygotsky, human mind develop through interaction with materials in the learning process where people learn from each other and use their experience to successfully make sense of the materials they interact with. These experiences are crystallized in 'cultural tool' and the learners have to master such tools in order to develop specific knowledge and skills in solving specific problems and in the process, become competent in specific profession.

In the classroom, these tools can be a picture, a model, or pattern for solving a problem. Most often however, such tools are combinations of elements of different orders, and human language is the multi-level tool same level excellence, combining culturally evolved arrangements of meanings, sounds, melody, rules of communication and so forth. Teaching/Learning by using such IIMs is not something that simply helps the minds to develop. Rather, this kind of learning leads to new, more elaborated forms of mental functioning. For example, when children master such a complex cultural tool as human language, this results not only in their ability to talk but leads to completely new levels of thinking, self-regulation and mentality in general. It is the specific organization of this tool (e.g. the semantic, pragmatic and syntactic structures of language) that calls in to being and in effect shapes and forms new facets of the child's mind.

In other words, they represent the functions and meaning of things, as discovered in cultural practices; they are ''Object-that-can-be used- for-certain- purpose'' in human societies. As such, they can be appropriated by child only through acting upon and with them that is only in the course of actively reconstructing their meaning and function. And such reconstruction of

cultural tools is initially possible only in the process of cooperating and interacting with other people who already possess the knowledge (i.e. the meaning) of a given cultural tool. This short account is presented here to illustrate the fact that the Socio-cultural approach, unlike that of instructional material by Gagne discussed above, not only allows for a synthesis of teaching, learning and cognitive development; it actively call for it. This theory implies that improvised instructional materials leads to cognitive development because they mediate learners' thinking through the real objects & tools, and such mediation constitutes the very cornerstone of mental development.

2.3. Knowledge Gap

Most studies that look in to the students understanding and performance, do not attach it with inadequacy or lack of instructional materials. (Sumra and Rajani, 2006;) have lamented on poor performance in Secondary schools, they did not link this situation with inadequate quality instructional resources. The above studies are clear that there is a problem in both primary and secondary schools of South Sudan and is directly to the schools both in Rural and Urban areas that can't improvised with instructional material and hence, it will contribute to the literature on the quality education in south Sudan.

2.4. Conceptual frame work of Learning/Teaching

Education is a human right and the main path of delivering such education is the school. Rousseau (2006) stressed that schooling is a system within a society that teaches students to learn the knowledge needed to become functional members of the society as adults". Schooling is process by which students gain knowledge through modalities of teaching, management of environment and the use of specific practices that allows for the best learning experiences. The purpose of the school is to prepare the young for future responsibilities in life by means of acquisition of an organized body of knowledge and skill which enable them to function effectively in the later life. The importance of education in connection with school pupils is the leading role it can play in promoting education for sustainable development, and to links the importance and meaning of sustainable development to everyday living. Education is one of the most important single instruments of change in any society, and the main avenue of delivering such education is the school.

The school has been recognized as an enduring human institution. Changes in schools, in most cases have been on physical structure rather than of the condition of teachers and their

pupils. Upper classes education aims at preparing individuals for usefully within the society and for higher education. The major causes of inadequate use of improvised instructional materials IIMS in primary schools according to Awosiyan (2005), can be summarized as:

a) High enrollment rates, inadequate facilities and materials as well as irrelevant curriculum.
b) Teachers not properly trained in terms of material development and utilization.
c) Poor access to materials to most junior secondary school teachers in both urban and rural areas
d) Poor environment to store and maintained such material for future use.

The availability and utilization of instructional materials at lower levels will help to enhance the quality of input into the higher level and consequently impact positively on the outputs of the higher levels. Teachers are regarded as implementers of curriculum and the also determine the quality in the school. The national policy on Education equally recognizes the significance of teachers in the educational system (Ogunlade, 2005) the primary concern of all teachers is to teach. Teachers own students their best efforts in providing meaningful learning through the use of different types of materials in teaching. The production of learning materials in support of curriculum depends largely on government policy. The government promises of the availability of the materials are still very inadequate. The availability and accessibility to instructional materials in primary schools will surely predict the use of materials, (Abdullahi, 2010). The availability of learning material has long been recognized as an important factor in educational attainment. Educational performance is determined by the teacher`s knowledge of the subject matter and pedagogical skills, the availability of learning material as well as time spend by pupils in learning (UNESCO,2000).

School environment has been described as an organization where resources are produced, managed and organized in such a way that enables the students to acquired desirable learning competencies. The process of managing and organizing resources is called resource utilization. The utilization of resources in teaching brings about fruitful learning because it stimulates student sense as well as motivating them. A clear focus on the primary motivation for entering teaching should undoubtedly compel committed teachers to become resourceful in the midst of little or no support. Such teachers should explore all possible resources, materials and equipment that would enable them to carry on with their primary task of teaching and create conducive

learning environment for their beloved students. Students often tend to see science as difficult to understand and its main ideas as an abstract and remote from everyday life experience (Braud, 1999).this means that more should be done to make science friendlier and more real to them. Despite the role of science as a discipline in people`s life in our societies, students still do not have interest in the study of science.

Probably lack of pupil`s interest in science may be as a result of science teacher`s inability and lack of interest in the improvisation of instructional materials. Research has shown that effective use of instructional materials arouse students` interest (Agwagah), 1999; Uzoegwu, 2001) it is therefore expected that in the absence of the commercially made instructional materials for teaching and learning of science, teachers should improvise. Ezegb (1999) emphasized the importance of the use of objects or materials in our environment in achieving set objectives. According to Abdullahi (2000), modifying traditional teaching methods will be very difficult as most teachers have conservation attitudes towards the use of instructional materials in teaching. Also lack of fund, equipment and time are known obstacles to successful media integration in teaching, (lam, 2000). Wadi (2003) stated that, `learning is enhanced when student can interact and perform authentic tasks.

A classroom is an opportunity to expose student to people who apply knowledge in practical context. The essential assignment of teaching is to support learning. Therefore, teachers should create classroom. Communities that considered thinking and problem solving are supported by extensive interaction of students with improvised instructional materials. The quality, speed and effectiveness of learning depend much upon the kind of learning situation and environment available to the learner. Learning is the product of activity and environment, the more the learner responds actively to the stimuli present in the learning environment the more he progresses in terms of learning outcome. The mind on the other hand is the cognitive mechanism that processes varied perceptions into specific concepts and understanding which are essential for the constructing deep understanding, development of attitudes, appreciation and the like. The use of improvised materials in teaching –learning process provides experience that is concrete and realistic. This implies that real and concrete experience leads to the development of deep understanding of topic content which is turn enables learners to solve their own problems. According to Shah (2007) for effective teaching-learning process, individuals who wish to become great teachers must be willing to sacrifice time and effort to reach their goal of solving instructional problems by integrating instructional technology into the classroom.

A classroom is one of the facilities of learning in formal settings. The best classroom environment is one of results in efficient learning. Effective learning involves employing guidance and instructional materials to encourage pupils to become self-directive thereby creating an atmosphere conductional for learning. The relevance of such instructional materials to pupil's interest is a factor in readiness to learn. The coming generations of our modern society will need knowledge and a skill for which today`s curriculum only forms a foundation. Discovering and understanding that are on the forefront of today`s research will be essential and fundamental parts of their world. Therefore, the success or failure in the task of learning in terms of introducing desired modification in the behavior of the learner depends automatically upon the quality, control and management of the three learning elements and their related factors; methods, available resources, and environment (Brijesh, 2007).

2.5. The Extent to which Improvised instructional materials affect students' performance and understanding

In his study Adeogun (2001) revealed a strong positive link between instructional resources and academic performance. According to Adeogun, schools that possess more instructional materials performed better than schools that have less instructional resources. This finding supported the study by Babayomi (1999) that private schools performed better than public schools because of the availability and adequacy of teaching and learning materials. Adeogun (2001) note that there was a low level of instructional resources available in public schools and hence commented that effective teaching and learning cannot occur in the classroom environment if the essential instructional resources are not available. Fuller and Clark (1994) suggested that the quality of instructional resources processes experienced by a learner determines quality of education. In the view they suggest that quality instructional resources create in to the learner's quality learning experience. Mwiria (1995) also supports that students performance is affected by the quality and quantity of teaching and learning resources. This implies that the schools that possess adequate teaching and learning such as textbooks, charts pictures, real objects for students to see, hear and experiment with, stand a better chance of understanding and performing well in science content and examinations. A study by Chonjo (1994) on the physical facilities and teaching learning materials in primary schools supports the above views. Chonjo interviewed teachers and students on the role of instructional materials on effective learning. From his study he learned that performance could be attributed to adequate

teaching and learning materials and equipments that are in a school. He recommended that in order to provide quality education the availability of sufficient quality facilities is very important. Chonjo's study was one of its kind in South Sudan which directly linked the roles of physical facilities IIMs with students' understanding and performance in upper primary schools. However, Chonjo focused only on physical facilities, leaving out instructional materials. To me physical facilities such as buildings including classroom, chairs and desks are not enough to provide quality teaching and learning. Instructional materials are also necessary. The study done by Maundu (1987) matched with my ideas that in order for a school to have deep understanding and performance, it must be well equipped with relevant and adequate textbooks and other teaching and learning materials like IIMS.

2.5.1. Improvised Instructional Materials

Improvised materials have been used across a number of scientific disciplines. For example, Ahmed (2008) presented in his study some biological instructional materials that biology teachers can improvise to replace the standardized ones. Biology teachers should find out materials from their local environment that they could improvise without losing the originality of the concept which is taught. Examples of these improvised materials include replacing D.N.A. models with stripped cardboard for illustration in teaching genetics, using hanger (pegs) in place of test-tube holders, replacing measuring cylinders with graduated feeding bottle for measuring liquid and so on. Onasanya and omosewo (2011) discovered in their study that the use of improvised instructional materials have the same importance in the teaching and learning of physics. This study`s result showed that both improvised materials and standardized materials were successful in teaching the students. science teachers should teach with improvised materials if the standard ones are not readily available to enhance effective teaching and learning.(Aina (2013) also investigated the necessity of using improvised materials to replace scare standardized instructional materials in teaching physics in schools.

This study showed the difficulty in teaching science in schools where there is an unavailability of standardized instructional materials. Furthermore, the paper elaborated the use of improvised instructional materials in advancing teaching and learning of science. Similar studies have also been conducted in mathematics. For example, Clement et al. (2014) presented the effective use of improvised instructional materials in teaching a concept in Geometry in higher levels. Improvisation was applied in teaching geometry in this study, and from their results, the use of improvised instructional materials significantly improved studies'

performances more than teaching the concept without improvised materials. Ramelglima et al. (2013) designed a color chart of Acids –Base indicators from indigenous plant extracts to assist in the teaching and learning of chemistry. The leaves and flower plants in the local environment were collected for the study. The paper discussed that plants are known to contain pigments like anthocyanin that provide color to their flowers, leaves, stem, root and fruits. The design of the color chard helped in teaching about acids and base in the classroom

2.5.2. Significance of using improvised instructional materials (IIMs)

The use of locally produced instructional materials in teaching and learning has many advantages Ahmed (2008). The use of improvisation in teaching makes the concept more practical and subsequently reduces abstractions. Again, they are cost effective, because they could be obtained from the local environment. They are generally very safe to use during demonstrations and experiments; it might not be capable of inflicting injuries, which means it could be hazard fee. In addition, they serve as a motivation to learner in as much as they actively participate during the production of the materials and also arouse learner` interest. Moreover, the use of these materials minimizes concerns about breakage, repair and loss since they are readily available in the environment. It informs both students and teachers that alternatives for some of the conventional science teaching materials are possible. It also shows that people can do scientific experiments with the materials around them.

Locally produced instructional material is making the substance from available materials when the real equipment is not available (NERDC, 2005). The use of instructional materials in teaching could extend the scope and power of instruction. It could also help to bridge the gap between the teacher and students in terms of understanding different concepts in the lesson, thereby making learning more immediate and more relevant. To make teacher education programmed more viable, there must be room for adoption of new principles and procedures in instructional technology that are necessary for growth n learning. This calls for more concern with improvisation of materials through local initiatives. Balogun (2002) opined that, locally produced instructional materials encourage creative expression and foster experimentation, sensitive to tactile and visual experience improves. Creativity in classroom environment communicates to children and teachers what is expected of them and what is happening in the classroom. A well planned environment is inviting and interesting and conveys a message. A resourceful teacher is one who, when faced with a problem considers a variety of solutions and chooses the most appropriate ones. In the absence of readymade resources, a teacher improvises

appropriate alternatives to, solve the problem. Teachers normally prepare local materials in order to promote the physical, social, emotional and cognitive growth of learners. The materials are designed to encourage learners to be curious and take initiative by exploring and interacting with other learners. Students learn when their thoughts and expectations interact with materials, ideas, and people; such interactions, according to Judy, (2004), gives learners meaningful development learning experience''.

Locally produced instructional materials give teacher/student the pride of using their talents allow a teacher to reproduce his potentials, in concrete form and increase teacher`s knowledge of the subject matter. Holmes (2000) opined the widespread recognition of the importance of local materials on teaching will encourage teachers to produce instructional materials for use in the teaching learning process''. They save the teacher`s time, simple to make require little explanation by the teacher for students to understand them. When effectively utilized by the teacher, locally made materials help to stimulate student`s interest, reduce the number of verbal responses and provide experience not easily secured in other ways.

Furthermore, Ramel-galima et al. (2013) indicated that the use of indigenous local materials is definitely safer, cheaper and cultural sensitive alternative to use of commercial and factory produced chemicals. When teachers and pupils use improvised instructional materials, it could lead to the discovery of new knowledge, and pupil's talents may be discovered. Using improvised instructional materials assist teacher economically and may make students more interactive. Beyond these, it makes students makes use of their intellectual ability in the process of teaching and learning (onasanya and omesewo 2001). A very important opportunity of using improvised materials for experiment is that, it enables learners to participate fully in the actual construction of the apparatus and gives them more ideas about how such materials work. Again, improvised instructional materials bring home to the classroom, and clarify unfamiliar principles and concept of science to learner's .more so, when teacher's improvised instructional materials for teaching, teachers` develop their potentials.

It therefore follows that resources may be both human and non-human provided they facilitate the acquisition and evaluation of knowledge, skills, attitudes morals and values (Esu and Inyang- Abia, 2004).

Improvised instructional materials according to NTI (Module Two) are of paramount importance in the teaching and learning of science because of the following functions they perform:

- They increase the rate of learning and at the same time allow the teacher to use more time on other gainful activities.
- They affect a reality of experience that stimulates self-activity on the part of the learners.
- They provide learning experiences which are not within the immediate classroom environment.
- They discourage rote learning by emphasizing realistic learning.
- They make abstract term, concepts and generalizations more practical and realistic.
- They help the learners to focus their attention during teaching –learning process.
- They provide the teacher with the means of guiding and controlling the desirable repossess of the learners in relation to stimulus materials of the learning situations.
- They develop in the leaner's, awareness of problem, open up possibilities for expiration, present meaningful interactions which naturally lead to provision of solutions.
- They help to stimulate purposeful and utilized self-activity and this is much more preferable educationally than a more or less passive and often bored listening.
- They improve the classroom communication process between the teacher and the learners, with this, the expected improvement in learning output will be accomplished.

Also, improvisation according to Tikon (2006) serves the following purposes in the teaching – learning process:

- It ensures the realization of lesson objectives
- It gives room for a teacher to demonstrate his creative skills
- It gives room for the use of cheap local materials as alternatives to the ready –made ones;
- It enables teachers to think of better and faster methods of making teaching – learning process easier for learners;
- Afford students the opportunity of becoming familiar with available resources in their environment.

2.5.3. Rationale for improvisation of instructional materials

Effective learning requires that concepts be exposed in a variety of contexts. This cannot be possible without adequate and diverse teaching- learning materials utilized by a resourceful teacher (Adeyaju in Eminah 2009). Learners differ in several respects. The social and intellectual background of each learner is different. Hence not all the available materials meet the needs and interests of learners. Therefore provision of locally produced is instructional materials is the logical action to take for balancing activities among the different categories of learners. According to Ogbeh, (2007); rational of improvisation include the following:

- It contributes to the achievement of our education objectives by providing opportunity to develop necessary skills, attitudinal and practical skills needed to function effectively in the society.
- Improvisation undertaken by the teacher enables him to rethink and research for cheaper, better and fosters methods of making the teaching or learning process easier for the students. This implies, it promotes creativity and self –reliance.
- To some extent, improvisation fills the vacuum created by lack or shortage of equipment by providing a frame of reference on which students can key their attentions during classrooms activities
- Improvisations provides a cognitive bridge to lead students from abstraction and its attendants mental indigestion to a nodding acquaintance with reality, scholars refer to this as giving students the bread of living experience rather than the stone of abstract theory.
- Situation where equipment are available but not affordable and / or where technical expertise for saving or repairing equipment is lacking, or spare parts an replacement items are not readily obtainable, clearly score the need for improvisation.

Based on the above rationale, the educational benefits of improvisation of instructional materials for teaching science cannot be farfetched. Ideally, no effective education programmed can exist without instructional materials. Similarly, Alasoluyi (2012), quoting a Chinese adage said. “A look is worth thousand words”. This statement illustrates the value of teaching and learning materials in enhancing effective learning, he also said that; these materials do not achieve any of the attitude values on their own. Rather, that their usefulness depends on what the teachers make out of them. Intelligent handling of the improvised instructional materials in the classroom is necessary (ogbeh, 2007).

Limitation of using improvised Instructional materials

Most improvised instructional materials lack precision and accuracy in measurement which may eventually undermine the exact outcome of the experiment (Aina 2013). Sometimes the cost involved in designing these materials may be more expensive than buying the original ones. Again, the available materials may not be suitable or appropriate for the lesson and can subsequently yield unexpected results. This can make learning more difficult and frustrating. Sometimes improvised materials may be expensive, and there may not be enough to teach a big class. Furthermore, improvisation demands creativity, adventure, curiosity and perseverance on the part of the teacher, such skill can be realized through training programs with the instructional materials. The perception of some teachers towards improvisation could also affect other teachers positively or negatively in the production of instructional materials

Concept of 5E constructivist Approach

Argument on learning cycle, 5E model was developed by Robert Bybee. According to Bybee, (1917), the foundation of this model was affected by work of German Philosopher Freidrich Herbart. Furthermore, in his view, this model is based on the ground of John Deway and Jean Piaget. As a very frequently used model in constructivist learning approach, 5E learning cycle model's name from the number of its phases and initials of each phases. These five phases are: Engage/Enter Explore**,** Explain**,** Elaborate and Evaluate.

Phases of 5E learning cycle model

1. **Engage**

The purpose of this phase is to focus students' attention on the topic. Asking pointed questions, explaining a scenario, demonstration of an event, showing a picture or making discussions can be used to focus the students' attention on the tasks that will follow and connections to past learning and experience can be invoked (Ergin, 2006). In this phase, there is no lecturing and the concept to be taught will not be given to the students. Students should be encouraged and tasks for learning are defined. In this phase, past experience are connected with actual experiences. The basis of work for upcoming activities is organized. Students derive some questions and try to find answers to them. For teachers, this phase provides opportunities for determining their students' misconceptions (Balci, 2005). In addition, this phase can be used to create disequilibrium in students' mind and to motivate students for using related real-life situations. In this phase, where teachers ask questions for arousing students' interest about topic

and for motivating them, teachers avoid defining and making explanation about concepts (Carin and Bass, 2001). This aroused interest leads students to the ‘’explore’’ phase where they use concrete experience for observation, collect information, test and reformulate hypothesis (Wilder and Shuttlworth).

2. Explore

Motivated to the subject in engage/enter phase, students makes some research activities which consists of gathering data, observation, guessing and testing them and making hypothesis (Wilder and Shuttleworth, 2005). The step, where students trying to understand and explore the subject via only their own experiences and thoughts, by making and testing hypothesis, can last short or long (Temizyürek, 2003). After giving short explanation about the activity that will follow, teachers can give to students a concept map to fill out, may want students to make experiments or may make organize a demonstration. Students can work in small groups for this activity (Lord, 1999).

The phase that students make the most activities is the explore phase. In this phase, students try to solve the given problem by working, discussing and experimenting in groups. Meanwhile, teachers should only guide students, not participate entirely to the students’ work. While guiding, if a teacher sees students’ mistake, he/she should not directly correct it, but should give some hints or show ways to students for correcting themselves. As students interact with each other, they are not passive in this process. They can announce freely opinions, test every idea and en-register the results. They try to interpret and explain the results of their observations (Carin & Bass, 2001).

3. Explain

In the explain phase, students explain scientifically the results obtained from their observation and data. Appropriate verbal repertoire should be associated with students’ data and experiences (Wilder & Shuttleworth, 2005). A representative in each group, formed in the explore phase, explain the results of their work and let their friends about them. The explain phase is a teacher-teachers phase in 5E model; because teachers become active for correcting mistakes and completing the missing parts in students’ results. Teachers may choose lecture method or may use another interesting method like showing a film or a video, making a demonstration or giving an activity which leads students to define their work or to explain their results. In this phase, teachers give formal definitions and scientific explanations. Furthermore,

by giving explanations in basic knowledge level to students, teachers, whenever possible, help them to unify together their experiences, to explain their results and to form new concepts (Bybee, 1997). The aim of this phase is to correct mistakes in students' findings before the next phase (Han¢er, 2005).

4. Elaborate

In this phase, students can practice their new knowledge, suggest solutions, create new problems and make presenting a new research activity or by expanding the activities done in the explore phase (Wilder & Shuttleworth, 2005). Working in groups also in this phase, students are close to end the asked problem. The groups present and explain their final situations. This phase can be considered as the extension of research step because of the existence of the supplement problems. Small group works or whole class discussions provide opportunities for students to understand the subject, to defend and present their thoughts. To use the new learned concepts in different situations or to repeat several times the applications related to the concept is necessary for being put in the long term memory and being permanence is supported.

5. Evaluate

The evaluate phase has the importance in determining whether or not the students learn the concepts correctly in scientific context and reflect it to the context. This phase may be realized in formal or informal method (Wilder & Shuttleworth, 2005). In this phase, some evaluations are made for revealing students' constructed knowledge. Students may answer to oral questions, make short summaries, and fill out empty maps, read graphs and evaluating tables. Furthermore, students are asked to associate what they have learned, with real life situations. This phase is the phase where students may exhibit their attitudes about learning and may change their thinking style or behaviors. The evaluation is realized over and over whenever teachers and students try to control the development in reaching to new comprehension (Han¢er, 2005). This phase reveals how students constructed scientific knowledge and they generalize it to other situations (Wilder & Shuttleworth, 2005).

Conceptual Understanding of acids and bases concepts of chemistry
Children`s learning

In these studies, researchers have worked to identify children`s alternative conceptions of science concepts, understand how children construct an understanding of science (acids and bases concepts) in classrooms, study how language shapes children`s idea and understandings, and conceptualize teaching and learning in science from a social perspective (Akerson, Flick, &

Lederman, 2000; Crawford, 2005; Hand et al, 2003). Currently, research on compiling list of children`s alternative conceptions has moved toward asking questions about how knowledge of these alternative conceptions may have implications for teaching practice and science programs. Researcher has reported that teachers should be aware of the following ideas:

Children`s Existing Ideas

Children have many existing ideas about science topic prior to classroom instruction. These existing ideas contain a mixture of scientifically correct and incorrect ideas. Children have difficulty understanding science ideas that are contrary to personal experiences (Chiu & Lin, 2005; Liu& Lesniak, 2006; Shapiro, 1995). A lifetime of learning demonstrates the importance of taking into account and attaching a high value to personal efforts to learn and make clear how the personal frameworks that learners develop persist and influence learning (Shapiro), 2004). Teachers need to develop and use formal assessment tools such as pre-tests and interviews to find out children`s existing ideas (Morrison & Lederman, 2003. Well-thought out teacher interventions can change children`s ideas more toward scientific conceptions (Sharp & Kuerbis, 2006). Teaching may promote even alternative conceptions (Liu & Lesniak, 2006).

Children`s Experiences

A complete explanation of how learning occurs must include a consideration of the experience of the learner, the participation in teach (Shapiro, 2004). Teachers need to focus on children`s experience outside the classroom and their engagement with science content (Pugh, 2004). Younger students are more interested in the environment than adolescents. This interest can motive students at an early age to become involved in environmental and scientific issues (Preneau, 2002).

Children`s understanding

Children need to go beyond mere observation and description to deeper concepts and authentic explanations (Ford, 2006). Children frame their understandings of science investigations with reference to three types of mental contexts: imaginary, experienced and investigative worlds (Shepardson & Britsch, 2001). Pupils understand the same concept in different ways. Their understandings and the ways they construct meaning are rooted in situational contexts and in their own individual contexts. What make meaning for children is not simply what words are used but how the explanation sits within each child`s wider narrative

context: the links that are made to events and memories and the personal values that colour and shape understandings (Tytler & Peterson, 2004a & 2004b). Children`s use of scientific language does not reflect their understanding (Liu & Lesniak, 2006). Children have difficulty understanding how macroscopic observations might be related to microscopic explanations (e.g., the particulate model of matter) (Liu & Lesisk, 2006). Children should be encouraged to question accepted theories in order to develop deeper understandings of those theories (Freeman & Mrazek, 2001) Children may necessarily use scientific conceptual knowledge developed in science to inform how they work during their design technology activities. Students` technological conceptual knowledge may be highly contextualized and situated (Levinson,Murphy, & McCormick, 1997 in Liu, 2000). The passage of time exerts strong influence on children to fall back from scientific to everyday ways of describing concepts. Children tend tom avoid using unfamiliar scientific terms and knowledge (Hellden & Solomon, 2004).

Prior Researches on student's misconception on acids and bases concepts of chemistry

Misconception is the idea/view that does not correspond with the idea/view that has been accepted by the scientific community (Demircioglu et al., 2005). Misconceptions can interfere students' understanding of concepts, especially basic concepts like acid and base. Studies showed that students have problems with some chemistry topics. Griffiths (1994) identified this topic that lead to misconceptions as chemical equilibrium, acids and bases, electrochemistry, the nature of matter, bonding, physical and chemical changes and solutions. Gamett et al, (1995) stated the list of their study as chemical equilibrium, acids and bases, electrochemistry, the particulate nature of matter and covalent bonding, molecules and intermolecular forces. There are many studies focusing on the particulate of matter (Novick and Nussbaum, 1978), mole concept (Novick and Mannis, 1976), and Chemical equilibrium (Wheeler and Kass, 1978), chemical and physical changes (Hesse and Anderson, 1992).

Acids and bases chemistry is one of the basic concepts in chemistry because most of the reactions are acid and base reactions. But, most students hold misconceptions about acids and bases. Cros and Maurin (1986) examine the first undergraduate students' misconceptions about acid-base chemistry. Banerjee (991) developed a test to diagnose the misconceptions in chemical equilibrium including acids and bases equilibrium. He determined the following misconceptions; rain water is neutral, for the same concentration of acetic acid and hydrochloric acid solution, P^H of the acetic acid will be less than or equal to the P^H OF HCL solution in water. There is no

hydrogen ion in the aqueous solution of NaOH. Ross and Munby (1991) investigated the senior high school students understanding of acids and bases concepts. They reported the following findings; all acids are strong and powerful, substances that burn are acids, all acids are poisonous, fruits are basic, strong acids contain more hydrogen bonds than weak acids, all substances with sharp or strong smell are acids, acids test biter and peppery, soil couldn't be acidic because it is unlikely for something to grow in an acid. It was also reported that students' difficulties with ions and ionic equations prevent students from making correct links among ions, PH and other related concepts. Bradley and Mosimege (1998) studied the undergraduate students' teacher's misconceptions about acid and bases. They reported the following misconceptions; aqueous solutions of all salts are neutral, indicators are used to test whether an acid is weak or strong. Indicators neutralize the acidity property of a solution.

Summary

This chapter of the study presented the relevant literatures. The first part at theoretical literature; this is focused on two theories; instructional materials theories and socio-cultural theory of teaching, learning and development. The second parts presented empirical literature that revolved around the three objectives which are developed in chapter one of this study.

CHAPTER THREE

3. Methodology

3.0. Introduction

This chapter presents the methodologies which were employed in the study, hence these common elements such as research design, study area, population of the study, sampling techniques, intervention plan, Source of data, data gathering instrument, data collection procedures,, study variables, data analysis techniques and Ethical considerations of the research was presented.

3.1. Design of the study

In order in investigate the effectiveness of Improvised instructional material IIMs employed in 5E constructivist method on students deep understanding of Acid and Base concepts. The researcher conducted a designed based research process. The designed based research by definition is a systematic study of designing, developing, implementing and evaluating educational interventions. In this study quasi-experimental research design was used because the study used pre-test and post-test with in experimental and control group. Two classroom achievement test, pre-informal classroom assessments and classroom observations which are pre-test and post-test tool that was used for gathering information. The intervention was designed for this study in three stages; pre-assessment – Experimental – Post – assessment. In the pre-assessment, the learners were given achievement test to answer on the knowledge they had of the on the previous units taught without using any improvised instructional material.

The class was divided in to two groups experimental and control groups. Learners attended lessons in two different groups namely Class eight controls (CG) and Class eight experimental (EG). In the CG class, the teacher used traditional instructional approach without any improvised instructional material for teaching the concept of acids and bases. In EG class, the teacher taught his lesson using 5E constructivist method with a number of improvised instructional materials. The two groups answered a variety of questions before and after the experiment to determine effectiveness of improvised instructional materials.

3.2. Conceptual framework of the Study

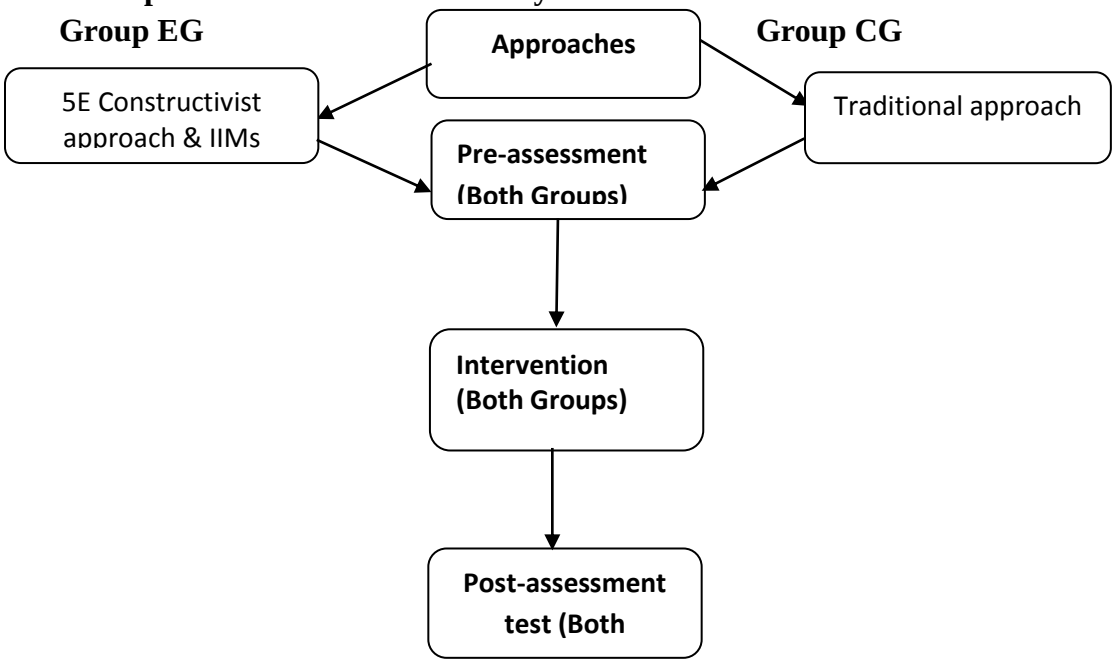

Fig2: *Conceptual framework of the study implementation*

3.3. Source of Data

The source of data for this study was primary eight pupils from Gudele East One primary school in Juba, South Sudan. Gudele East One primary school was selected because it had got the advantage of being the biggest, overcrowded government school with 90% of the teachers population are females and all are from Arabic background who are still needs more in-service teachers trainings in teaching methodologies and constructing improvised instructional materials.

3.4. Population of the study

The targeted population of this study was all the upper primary eight pupils in Gudele Primary school. From the school enrollment obtained from the school Head teacher the statistics of 2019 to 2020 was 75 students. Due to the Covid 19 lockdown and crisis, some of the learners dropped out of the school as a result of early pregnancy, force marriage for girls and joined bad peers group. Where 5 got married, 3 girls got early unwanted pregnancy and 5 boys joined bad peer groups. The total number of pupils remaining is sixty two pupils in single class room (38 girls and 24 boys). The table below will show the categorization of girls and boys in the class.

3.5. Population Size and sampling techniques of the study

From the total population, the sample of the study consisted of 62 students/pupils from primary eight class (male = 24 and female = 38) who were in one class of Gudele East One primary school during academic year of 2019 – 2020 South Sudan calendar and divided in two

classes during the research intervention. Random sampling technique was employed in this study because students are in the same level that was primary eight (P8). In this study two different instructional methods were assigned for the two classes that are Experimental and Control groups.

Tab3.1: Sample size used for the study

Group	**Male**	**Female**	**Total**
Experimental	13	15	28
Control	11	23	34
Total	**24**	**38**	**62**

3.6. Research Intervention plan

The intervention program of this study was continued for two weeks for each class, in each week three periods (2 double periods of 70 minutes and a single period of 35 minutes) of south Sudan curriculum. Multiple choice pre-test was administered before carrying out any intervention of instructional design, during intervention; six different lesson were implemented by two different instructional design, that mean Improvised instructional material using 5E constructivist method was applied in Experimental group and Traditional Instructional method was also applied on control group and post-test was used after the intervention. The classroom intervention for all class experimental and group was done by the researcher. In all intervention design was prepared on six subtitles of acids and bases topic. According to the two instructional approaches, IIMS and pre-test before the intervention and post-test after the intervention were given to both the experimental and control group.

3.6.1. 5E constructivist approach & Improvised instruction materials used for experimental group

The students in the experimental group relieved IMMs and 5E constructivist model instruction for acids and bases. Six separate 5E learning model lesson, the first was for acids and bases concepts of chemistry definition, the second was the examples of acids and bases. The third was the properties of acids and bases, the fourth was uses of acids and bases and the fifth was testing acids and bases using the universal indicator obtained from onion juice and the last was reaction of acids and bases. During the implementation of the sub titles, the researcher used IIMS and 5E constructivist method it consists of five phases, in the first stage, engagement phase, students' interest and motivation, to make students focus on the lesson and identify

alternatives conceptions by showing the real material of acids and bases and asked conceptual questions. In the second stage, Exploration phase, students observed and test the materials of acids and bases and discuss based on the questions raised in the first phase. In the third stage, Explanation phase, permit students to make sense of their explorations, here students explained acids and bases concepts. In the fourth stage, Elaboration phase, it gave the learners, the opportunities to expand their prior knowledge of acids and bases concepts to other contexts and finally the Evaluation phase, in which students' understanding was assessed by asking them several open and ended question based on acids and bases sub-topics. Since the main elements of 5E constructivist approach are; questions raised by the teacher (Tafoya et al., 2009), collaborative work, peer discussions, and students hand on or mind on an activity (Van Zee et al., 2005), the researcher has included the elements of 5E learning circle model the teaching/learning process. The general guidelines were followed by the researcher during the implementation of the intervention. The researcher implemented the lesson intervention about acids and bases concepts of chemistry for two weeks. (Detail 5E constructivist approach lesson plan see in Appendix C.

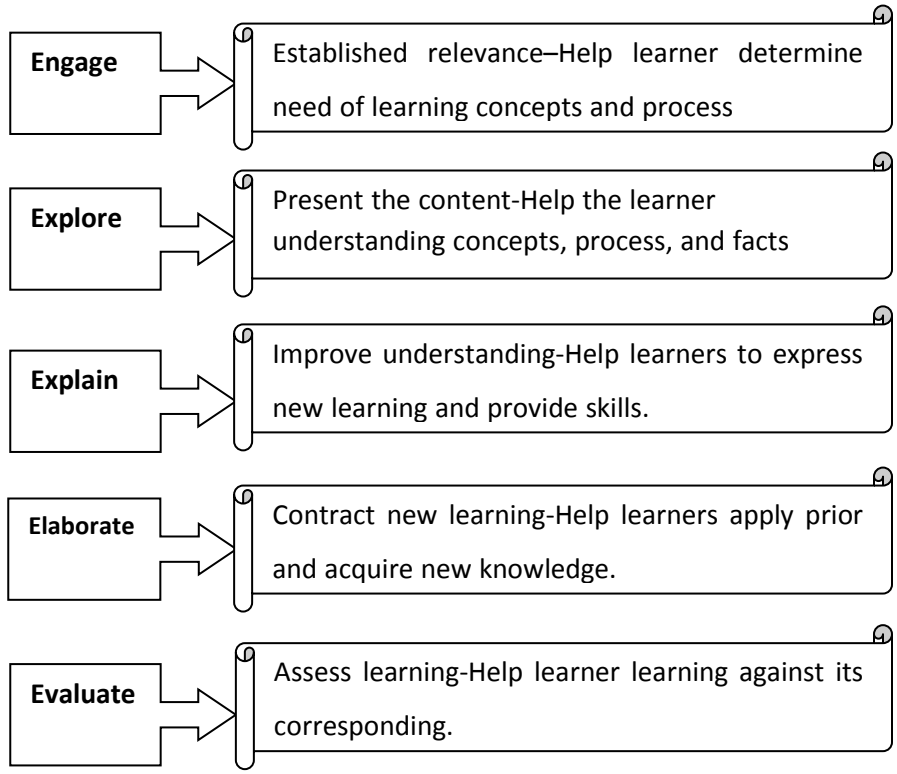

Fig3: *Flow chart of Bybee et al, (2006) model*

3.6.2.1. Narratives of classroom activities during intervention in EG Classroom

The researcher here prepared the lesson which covered the subtopics Acids and bases properties, examples, uses and testing. The lessons were started all with conceptual questions following the sequence stage of 5E learning circle model. Students were asked to identify substances/materials which contained acid and base and the one which is neutral to identify their misconceptions. The materials were place on each desk in front of the students and due to the lack of other materials from the school, students themselves comes with them from their homes.

The time, researcher has gave for learning the above subtopics were different according to hand on and mind on activities were given at the 5E constructivist stages; Engage, Explore Explain, elaborate and evaluation stages. In each subtopic, they are described briefly as follows. Acid and Base, the activities used by the researcher were, questions, observations and the students answered by their prior knowledge about acids and bases. Students went and test the fruits, ashes, water, juices, to find out and compare with their answers in the engaging state. Students with the help of the researcher prepared a testing reagent this was universal indicator from red onions to help them testing the present of acid and base in the solution. Following the activities which were used to meet the objectives of the learning, that were to define an acid and base, describe the properties and acids and bases, giving examples of acids and bases from fruits and laboratories.

At the engage phase, the researcher asked following conceptual questions, to elicit students' prior knowledge about acids and bases to find out their misconceptions and give them time to think critically over the questions for deep understanding of the topic concepts. Here were the questions the teacher asked the learners in the engage phase; *(Define acid and base? What are the examples of acids and bases? Where can we find the acids and bases? What are the properties of acid and base? How dangerous and important is acids and bases? Why you are not allowed testing an acid and base in the laboratories? How do we know that this is an acid or base?)*

The science teacher encouraged the students to answer the questions and late he listed to their response and he went to the Explore phase and didn't tell them the correct answers for the above questions only the students should get the answer by themselves from their exploration and experiences they got. At the explore phase, the teacher gave the learning materials IIMs to students to confront their misconceptions they have them during engage phase. This gave the

students opportunities to construct their own knowledge from the various activities they have carried.

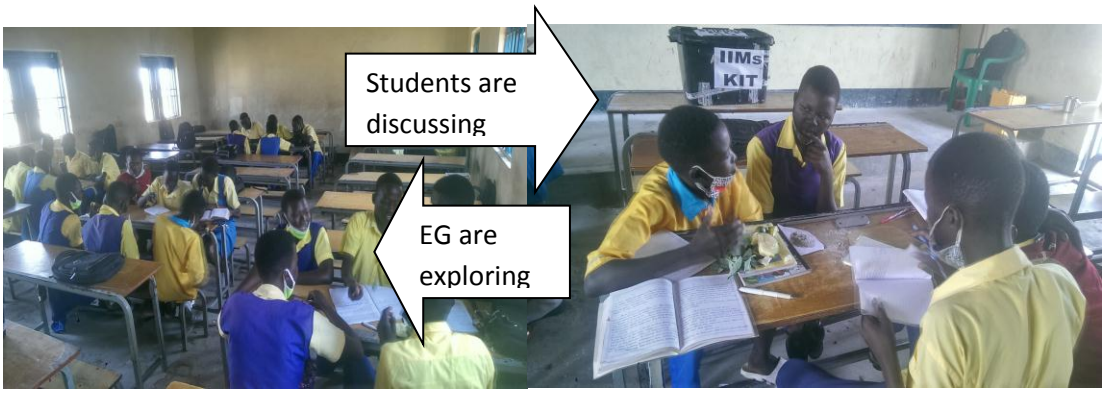

Fig4. *Students' activities on test and identifying an acid and base*

After their finding and discussion, the researcher asked the students with questions that can take them to the concepts which was targeted and helping them in adjusting their answers. As the teacher duty was to direct and guide them, he didn't give them the correct scientific explanation for the questions he raised and he only encourage the students to find out their own scientific explanations. At the stage of explanation, the science teacher asked the students to come and explain their experiences based on the findings and to relate the findings to the scientific concepts and acid and base and probed them during their presentation of their ideas, to anticipate how deep they have understood the concepts of the topic taught.

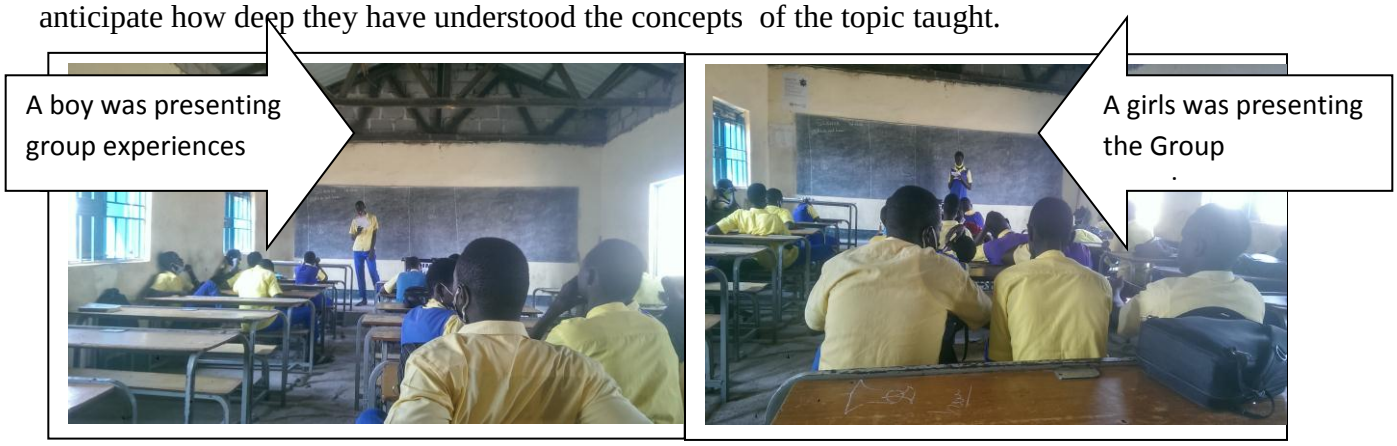

Fig5. Students' explaining the experiences from their findings

At an elaborate phase, the researcher asked the learners same above questions in engaged state. He listens to students' communications and helps them to do the activities again by testing the fruits, water and ashes. Lastly the researcher gave them some exercises to do in the class and project to be done at home. The exercises given are; *1. Without using an indicator, how could you test whether a food is an acid or base? Why should you never do this with another substance*

other than food? 2. Name the acid that is found in the human stomach. 3. Is potassium an acid or base? Why our bodies do needs it? 4. Name the special paper use for testing the presence of acids and bases and the project questions given to the students are*; 1. a. How do you describe an acid and base? Give some examples of acids and bases that have encountered in your everyday life. List any sour and bitter foods. 2. Achol has prepared milk for her child, after some, few days the test of the milk changes to sour. Is the test of milk containing an acid and base? What kind of acid or base is the sour milk Contain? What is the colour milk at that kind of test? 3. Name the acid that is found in the stomach. Without using indicator, how could you test whether the food is an acid or base? Why should you do this with any substance other than food? 4. Is sodium (kombo) an acid or base? Explain. If a bee bit someone, why is it pain too much? How do you reduce that pain from bee bite?*

3.6.3. Traditional instruction teaching approach used for Control group

Pupils in the control group received their lesson using traditional instructions method without improvised instructional materials which include introduction of the lesson, presentation, asking oral questions, coping notes, summarization of lesson covered and evaluation of the students by giving them exercise to do in their notebooks. In this kind of the instruction all the classroom activities were explained by the researcher who was a science teacher during the intervention. The content of the lesson includes, first was for acids definitions and examples, the second was the properties and uses of acids, third was for definition of bases and example, the fourth properties and uses of bases, the fifth was for test and summary of both acids and bases solutions and last sixth lesson was for exercise. Based on this study the researcher also implemented the lesson about acids and bases concepts for two weeks. (Traditional lesson plan seen in Appendix D)

3.6.3.1. Narratives of classroom activities during intervention for CG Classroom

The researcher here prepared the lesson which covered the subtopics Acids and bases properties, examples, uses and testing. The lessons were started all with introduction of the lesson, presentation, asking oral questions, coping notes, summarization of lesson covered and evaluation of the students by giving them exercise to do in their notebooks. The students were given the same questions asked by teacher for the experimental groups in the engage phase as their exercises to do in the notebooks at the end of every lesson without project to do at home. The teacher also asked some verbal questions during his lessons and summary. Here the students

can't able to express the scientific concepts of acid and bases. To the teacher eye witness, most students having such misconception any substance has red colour is an acid and with blue colour is a base. From the exercise given to them by the teacher, traditional method with improvised instructional materials shouldn't help in students' construction of deep understanding of the acid and base concepts.

3.7. Data gathering instruments

In this study, student's achievement in acids and bases test (pre-test and post-test), pre-informal classroom assessment and classroom observation were used as data collection instruments. The researcher adapted open-ended questions, which their validity and reliability had been proved, from other studies (e.g. Anderson and Kärrqvist, 1983; Anderson & Smith, 1986; Galili & Hazan, 2000; Golberg & McDermoth, 1986, 1987; Viennot, 2004). Because open-ended questions will give an opportunity for the students to bring up their misconceptions than multiple choice questions, in which the distracters will not contain all the misconceptions of the students (Ttrundle et al., 2002; McDermott, 1984). The two tests, pre-informal assessment and classroom observation were applied in both Experimental and Control group of students before and after the intervention.

3.7.1. Students' Achievement Test on acids and bases concepts

Students' achievement test is a quantitative method of data gathering instrument. The main understanding on acids and bases concepts was before and after treatment implementation. The test was developed by the researcher and it assessed mainly students' deep understanding of acids and bases concepts i.e. meaning of acid and base, properties, examples and uses. The pr-test and post-test contained the same questions, the pre-test have questions from topics which is going to be covered and post-test have question from the topic covered of the lesson implemented and the test was administered for both experimental and control group. Each question of the test had one correct answer and different distracters which reflected students' misunderstanding related to acid and base concepts. The clarity of the each question was evaluated by classroom science teacher (List of test pre &post-test question seen in Appendix A).

Pre-assessment test; The researcher developed a questions paper for both pre-test and post-test using the upper primary text book currently used in South Sudan. The responses were gathered from the Observation, checklist and the use of modified pre-achievement test for both

groups. The questions papers were given to the pupils to answers to find out their understanding of science concepts before the experimental work. One science teacher in the primary school was engaged in setting and viewing of question paper. Response and data of the interview and the question paper to be collected and analyzed.

Intervention Design; Students of Experimental group EG and Control group CG within the population and one-science teacher in primary school participated in the experimental work. The procedures of the experiment were well explained to pupils and science teacher before it start. CG group attended their lesson using traditional approach without IIMS. The group observed six to nine different solutions based on their test, color change in litmus paper and PH readings and recorded their observation. The second group EG have designed and produced improvised PH paper, acid-base indicator from red onions. The red onions were cut in the small slices. Enough water used to cover the slices in a plastic container and it was left to boil for fifteen minutes. Red liquid was obtained after boiling and allowed to cool down. Part of the liquid was used for acid-base indicator. Plain papers were cut into rectangular shapes and soaked in the remaining part of the red liquid. The papers were removed from the liquid and allowed to dry. It is then cut in to the strips about the size of the standard litmus papers. The papers were used to test the same nine different solutions, which CG group used to observe them only. They tested whether the solutions were acid or base and also added few drops of red onion juice to each solution and recorded their observations based on color changes. I.e. In acid solutions, the litmus paper change to red and in the base solutions, the litmus change to blue.

Post- assessment test; the post-assessment was aiming at finding out the effectiveness of improvised instructional materials (IIMS) in teaching the concept of acid–bases. After the experiment, pupils who participated in the experiment were given another set of question papers to answer with the knowledge they got on acid-base concepts.

3.7.2. Classroom Observation

The aim of this instrument was to observe the teacher and students' activities or reactions towards IIMs and 5E constructivist method for the experimental group and traditional teaching method for the control group. During the treatment, the classroom observation served to capture complete images of IIMs and 5E model classroom and traditional classroom. The observation type was semi-structured observation, in which it has guidelines to guide the observational

process throughout the treatment of the instruments for intervention. (List of observation check list seen in Appendix B).

3.7.3. Scheme of work and Lesson plan

In this study, the researcher used a 5E constructivist method lesson plan in it which consists of the topic, subject content, the objectives, knowledge skills, and procedure, teachers and learners activities for the five phases of the approach, IIMs and assessments.

3.8. Data gathering procedures

The data of this study was in three stages, before intervention, during intervention and after intervention. Before the researcher intervene of IIMs and 5E constructivist method and traditional way of teaching instructions, the researcher gave pre-test about acids and bases concepts of chemistry for both experimental and control groups. This pre-test was used to determine the prior knowledge of students about acids and bases concepts. During the intervention the students of Gudele East One primary school were taught using IIMs and 5E constructivist method for experimental group and traditional approach for control group students. The researcher observed the classroom behaviors, students' engagement, improvised materials used in presentation that integrated to acid and base concepts for experimental group. After the treatment of instruments of intervention, students' achievement post-test was given to both experimental EG and control CG groups. The post-test for both groups was administered to measure the students' deep understanding of Acid and Base concepts of chemistry using IIMs and 5E constructivist teaching method.

Validity of the Instruments

In order to ensure the validity of the study instrument, the advisor from Bahir Dar University has given a go ahead on data collection. The advisor has made necessary corrections or modifications and suggestions as to its construction and content before it was being taken for data collection.

Reliability of the Instruments

To determine the reliability coefficient (r) level of improvised science pupils achievement test (SPAT) was used for the study, data collected was subjected to comparative and statistical analysis. Hence, the reliability co-efficient was determined using Pearson Product Moment Correlation Co-efficient (PPMCC) which will yield the reliability coefficient value.

Variables

Independent Variables

In this study, the independent variables were two different types of instruments implemented during the intervention, the instrument based on IIMs and 5E constructivist approach and traditional designed classroom instrument were the independent variable employed.

Dependent Variable

The dependent variable of this study was students' conceptual understanding on acid and base concepts of chemistry.

3.9.Data analysis techniques

In order to investigate the effectiveness of IIMs on students' deep understanding of acid and base concepts, the research has to collected both quantitative and qualitative data. Data analysis involves examine the acquired information and making inferences (Kombo & Tromp, 2006). To check the difference of IIMs in 5E constructivist approach and traditional instruction teaching, the science pupils' assessment test (SPAT) for both the pre- test and the post-test were marked and compared for each respondent. The data that are generated from the science pupils achievement test (SPAT) were ordered, coded, categorized, classified, labeled and analyzed both quantitatively and qualitatively as per the objectives of this study. The statistically significance was test for all the pre-test and post-test of both experimental and control groups. The statistical package for the social science (SPSS) programme was used to analyze the data of this study. To calculate whether there is significant different or not on IIMs in5Econstructivist approach and only traditional teaching instructions on the students construction of deep understanding, descriptive statistics, paired sample t-test and independent sample t-test were used.

The results were compared at ''0.05''level of significance (α =0.05) and 95% of confidence interval by using SPSS program version 21 and any hypotheses that is greater than 5% or p= >0.05 was rejected and any hypotheses that is less than 5% i.e. p=<0.05 is retained. In analyzing the data, data collected was presented in a tabular form and response was calculated in percentages followed by detailed interpretation. Also, descriptive statistic such as mean and standard deviation were used to analyze the research questions.

3.13. Data presentation and analysis of the study

In this study, raw data were entered into the table for analysis using mean, and standard deviation. Data were checked before data entered in to the SPSS for completeness tables were used to summarize the data's collected.

Ethical consideration of the study

The research proposal and instruments of the study proposed were submitted to Bahir Dar University ethics and research committee (advisor) to be reviewed and it was approved before administering it. During conducting this study, the researcher announced to participant that this study will have No harm to the participants' academic program as it was never for other purpose other than research. After permission from the student, the researcher respects their ideas during the classroom interaction with their groups, regardless of boy or girl. Also the researcher asked and got a Permission to carry out the exercise that was obtained from the school authority with the backup of the authorization letter from the Bahir Dar University research committee. It is clear that without students' permission, no data disposed for other party. The participants did not get any form of financial or material bribe. The teacher had encouraged and motivated the students for their full participation and interest in learning. The confidentiality of this study is upheld.

CHAPTER FOUR

DATA PRESENTATION, ANALYSIS AND DISCUSSION OF RESULTS

4.0. Overview

This chapter presents the statistical data analysis of pre-test and post-test results; Descriptive statistical analysis of pre-test and post-test of both groups, inferential statistical analysis of data from pre-test & post-test scores; paired sample t-test analysis of pre-test & post-test scores, independent sample t-test analysis of pre-test & post-test scores, analysis of pre-test scores for experimental group & Control group, analysis of post-test scores for experimental group & control groups. Also the interpretation and discussion of; results from informal classroom assessments, results obtained from classroom observation and observation in experimental and control group classrooms. The purpose of the study was to investigate the effects of improvised instructional materials in students' deep construction of acid and base concepts.

Therefore, this study aims is to investigate two research questions and one hypothesis. The first research question, which address the observation of students on IIMs effectiveness in 5E constructivist teaching method; (*What is learners' observation on use 5E constructivist approach and improvised instructional materials?)* to answer this question that data obtained from pre-test from previous topics learned and post-test acids and bases assessment test.

The second research question, which also address the effectiveness of treatment on the variables; (How helpful are 5E constructivist approach and improvised instructional materials on teaching/learning acids and bases concepts toward learners performance?) to answer this research question the data also obtained from pre-test and post-test students achievement test and informal classroom assessments or classroom conversations and classroom observations.

The hypothesis of the study, which stated that, (There is statistical significant difference in students' conceptual understanding in chemistry concepts of acids and bases between experimental and control group students) to answer this hypothesis, the data obtained from pre-test and post-test achievement test were used.

4.1. Demographic Variables of the participants

This section present the demographic variables of the students involved in the study. The study found it necessary to gather this information as it offered data on the model individuality.

4.2. Participants' group type

The study used the quasi-experimental approach of the pre-test and post-test design. The participants were categorized as either the experimental or the control group. The experimental group consists of students taught topic of acid and base concepts by IIMs in 5E constructivist teaching method mean while the control group were taught using traditional teaching method with IIMs.

Table4.1. Distribution of participants' Group types

Respondents' Group	**Frequency**	**Percentage %**
Experimental	28	45.2
Control	34	54.8
Total	**62**	**100**

The data present in the table 4.1. Shows that 45.2% of the participants formed the experimental group and 54.8 % designed the control group. The percentage of applicants in experimental group is lower than the control group. This was because, the classroom that was used for control group is having enough space and other students joined after the randomly distribution of the students. Results were presents in the tables according to the two questions and one hypothesis.

Table4.2. Student General Performance

Table4.2. Students general performance in pre-test & post-test of the experimental and control groups									
	Experimental group			27		Control group		27	
	Pre-test		Post-test			Pre-test		Post-test	
S/NO	Marks	Remarks	Marks	Remarks	S/NO	Remarks	Remarks	Marks	Remarks
1E	9	Fail	27	Pass	1C	10	Fail	20	Pass
2E	10	Fail	17	Pass	2C	6	Fail	14	pass
3E	7	Fail	13	Pass	3C	10	Fail	6	Fail
4E	6	Fail	23	Pass	4C	12	Fail	21	Pass
5E	6	Fail	21	Pass	5C	12	Fail	19	Pass
6E	4	Fail	27	Pass	6C	10	Fail	10	Fail
7E	6	Fail	23	Pass	7C	11	Fail	8	Fail
8E	9	Fail	22	Pass	8C	10	Fail	11	Fail
9E	7	Fail	20	Pass	9C	7	Fail	15	Pass
10E	7	Fail	16	Pass	10C	7	Fail	3	Fail
11E	7	Fail	27	Pass	11C	8	Fail	7	Fail
12E	9	Fail	22	Pass	12C	7	Fail	12	Fail
13E	6	Fail	14	Pass	13C	7	Fail	10	Fail
14E	8	Fail	27	Pass	14C	6	Fail	9	Fail
15E	6	Fail	17	Pass	15C	10	Fail	14	Pass
16E	9	Fail	19	Pass	16C	9	Fail	4	Fail
17E	7	Fail	7	Fail	17C	7	Fail	0	Fail
18E	5	Fail	13	Fail	18C	7	Fail	8	Fail
19E	10	Fail	18	Pass	19C	9	Fail	8	Fail
20E	8	Fail	22	Pass	20C	7	Fail	21	Pass
21E	9	Fail	22	Pass	21C	7	Fail	14	Pass
22E	8	Fail	18	Pass	22C	Miss	Nil	19	Pass
23E	9	Fail	26	Pass	23C	Miss	Nil	3	Fail
24E	7	Fail	25	Pass	24C	Miss	Nil	15	Pass
25E	6	Fail	21	Pass	25C	Miss	Nil	4	Fail
26E	6	Fail	23	Pass	26C	Miss	Nil	8	Fail
27E	8	Fail	15	Pass	27C	Miss	Nil	8	Fail
28E	9	Fail	14	Pass	28C	Miss	Nil	8	Fail
					29C	Miss	Nil	12	Fail
					30C	Miss	Nil	11	Fail
					31C	Miss	Nil	11	Fail
					32C	Miss	Nil	15	Pass
					33C	Miss	Nil	12	Fail
					34C	Miss	Nil	13	Fail

4.3. Comparative analysis of pre-test and post-test scores of both experimental and control groups

Question1: How helpful are 5E constructivist approach and improvised instructional materials on teaching/learning acids and bases concepts of chemistry toward learner's performance?

Tab4.3. Comparative analysis of experimental group

		Pre-test				Post-test		
Questions	Correct	%	Incorrect	%	Correct	%	Incorrect	%
1	20	71.4	8	28.6	27	96.4	1	3.6
2	6	21.4	22	78.6	27	96.4	1	3.6
3	24	85.7	4	14.3	27	96.4	1	3.6
4	24	85.7	4	14.3	27	96.4	1	3.6
5	26	92.9	2	7.1	27	96.4	1	3.6
6	12	42.9	16	57.1	24	85.7	4	14.3
7	25	89.3	3	10.7	22	78.6	6	21.4
8	15	53.6	13	46.4	17	60.7	11	39.3
9	13	46.4	15	53.6	26	92.9	2	7.1

4.3.1. Narrative of comparative analysis of pre-test and post-test for experimental group

The data collected on students' deep understanding of acids and bases concept in table4.2. revealed that students taught acids and bases topic (properties of matter) using 5E constructivist approach and improvised instructional materials had highest scores in percentages of post-test than if they are taught without any improvised instructional materials. In question items of post-test scores of all students almost scored questions correct with a highest percentage of (96.4%) except question item 8 where only 17 students got it correct (60.7%) out of twenty eight students. The average percentage of students who scores good results in experimental group is 88.9%. In pre-test scores, the performance of the students was poor as it is an open-ended question item, the scores ranging from 53.6% to 92.9% with a lowest performance of 21.4%. The average percentage of the pre-test correct scores is 65.5% and incorrect scores results is 34.5% with an average percentage difference of 31%. Therefore, the students who were taught the concept of acid and base using improvised instructional materials and 5E pedagogical approach in primary eight have more understanding acids and bases concepts of chemistry.

Tab4.4. Comparative analysis of control group

		Pre-test				Post-test		
Questions	Correct	%	Incorrect	%	Correct	%	Incorrect	%
1	16	76.2	5	23.8	3	8.8	31	91.2
2	6	28.6	15	71.4	3	8.8	31	91.2
3	19	90.5	2	9.5	9	26.5	25	73.5
4	15	71.4	6	28.6	13	38.2	21	61.8
5	20	95.2	1	4.8	15	44.1	19	55.9
6	13	61.9	8	38.1	15	44.1	19	55.9
7	20	95.2	1	4.8	14	41.2	20	58.8
8	17	81	4	19	14	41.2	20	58.8
9	4	19	17	81	14	41.2	20	58.8

4.3.2. Narrative of comparative analysis of pre-test and post-test for control group based on percentage

The data collected on students deep understanding of acids and bases concept in table4.3, revealed that students' taught acids and bases topic (properties of matter) using traditional instructional method had lowest scores in percentages of post-test than if they are taught with improvised instructional materials IIMs and 5E constructivist teaching method. In question items of post-test scores almost all students failed the questions with a failed percentage scores of range from58.8% to 91.2% which means all the 34 students of primary eight (p.8) in post-test of control group didn't get the expected scores. The average percentage of students lowest scores (poor performance) in control group is 67.3%.

In pre-test scores, the performance of the students in control was fair compare to the post-test scores because optional answers were given to the students on open- ended question items, the scores ranging from 61.9% to 95.2% with a lowest performance of 19%. The average percentage of the pre-test of correct scores is 68.8% and of incorrect scores is 31.2% with an average percentage difference of 37.6%. Therefore, the students who were taught by the use of traditional teaching method in primary eight have less understanding and development of chemistry concept of acids and base.

Table4.4. Summary of comparative analysis of pre-test and post-test scores of both experimental and control groups

Table4.4. Comparative analysis of pre-test & post-test scores of both experimenetal and control groups																
		Pre-test							post-test							
	Experimental & Control group															
	C8C		C8E		C8C		C8E		C8C		C8E		C8C		C8E	
Question	correct	%	correct	%	incorrect	%	incorrec	%	correct	%	correct	%	incorrect	%	incorrect	%
1	16	76.2	20	71.4	5	23.8	8	28.6	3	8.8	27	96.4	31	91.2	1	3.6
2	6	28.6	6	21.4	15	71.4	22	78.6	3	8.8	27	96.4	31	91.2	1	3.6
3	19	90.5	24	85.7	2	9.5	4	14.3	9	26.5	27	96.4	25	73.5	1	3.6
4	15	71.4	24	85.7	6	28.6	4	14.3	13	38.2	27	96.4	21	61.8	1	3.6
5	20	95.2	26	92.9	1	4.8	2	7.1	15	44.1	27	96.4	19	55.9	1	3.6
6	13	61.9	12	42.9	8	38.1	16	57.1	15	44.1	24	85.7	19	55.9	4	14.3
7	20	95.2	25	89.3	1	4.8	3	10.7	14	41.2	22	78.6	20	58.8	6	21.4
8	17	81	15	53.6	4	19	13	46.4	14	41.2	17	60.7	20	58.8	11	39.3
9	4	19	13	46.4	17	81	15	53.6	14	41.2	26	92.9	20	58.8	2	7.1
Total	130		165		59		87		100		224		206		28	

In the summary , the average percentage of students who scores correct in post-test of experimental group is 88.9% and incorrect scores is 11.1% with an average percentage difference of 77.8% and average percentage of the pre-test correct scores is 65.5% and incorrect scores results is 34.5% with an average percentage difference of 31%.

In control group, the average percentage of students with lowest scores (poor performance) in post-test is 67.3% and the average percentage of students who got correct scores is 32.7%. The average percentage of the pre-test of correct scores is 68.8% and of incorrect scores is 31.2% with an average percentage different of 37.6%. The students who were taught the concepts of acid and base using improvised instructional materials IIMs and 5E pedagogical approach in primary eight, having more understanding of acid and base concepts of chemistry than those taught by use of traditional teaching instructions.

4.4. Statistical analysis of pre-test & post-test results

4.4.1. Descriptive statistical analysis of pre-test and post-test results for both groups

The mean, standard deviation, minimum and maximum scores of pre-test and post-test for both groups experimental and control groups of students achievement test scores were presented in

table4.6.3, both the experimental and control group students pre-test and post-test results was examined out of 27% as presented in the table4.4, above.

Tab4.5. Descriptive statistics of pre-test and post-test results for both experimental and control groups

Test	Group	N	Mini	Maxi	Mean	Std. Devia
Pre-test	Experimental	28	4	10	7.43	1.550
	Control	21	6	12	8.52	1.914
Post-test	Experimental	28	7	27	19.96	5.124
	Control	21	0	21	11.14	5.902
Total		**49**				

As presented in the table4.5, before the intervention, the results of the experimental group (mean=7.43, standard deviation=1.550, minimum score=4 and maximum score=10) and in control group was at the mean=8.52, standard deviation=1.914, minimum scores=6 and maximum score=12 and the same range of minimum and maximum score from experimental group. In both groups, the maximum value of pre-test score is 7.43, it appear to be under the midpoint of the results.

After the administering of intervention, it was found that, the students in the experimental group who were engaged with IIMs and 5E instructional model of constructivist approach oriented instruction demonstrated better understanding (mean=19.96, standard deviation=5.124, minimum score=7 and maximum score=27). Over the control group, students were engaged with only traditional teaching approach and it was found that (mean=11.14, standard deviation=5.902, minimum score=0 and maximum score=21).

Therefore, the results showed that before intervention administering in both groups students had low level of prior understanding with a lot of misconceptions in conceptual understanding (learning) of acids and bases concepts of chemistry where both groups almost having the same mean of which control group having greater mean (8.52) than the experimental group (7.43). After the implementation of the intervention experimental group students had better and conceptual understanding on acid and bases concepts of chemistry with a mean=19.96, that compared with control group students (mean=11.14).

4.4. 2. Inferential statistical analysis of data from pre-test and post-test scores

4.4.2.0. Independent t-test analysis of pre-test and post-test scores

Independent t-test is repeated measures test within subjects designed commonly used in comparing a mean of difference scores before and after designs intervention. To compare the effectiveness of IIMs on experimental group and control group by conducting independent t-test for pre-test and post-test scores of each group as shown in table 4.7 below.

Tab4.6. Independent t-test of both pre-test & post-test for experimental and control groups

				t-test for Equality of Means							
								95% C.I.D			
Test	**Group**	**N**	**Mean**	**T**	**Sig.(2-tailed)**	**Mean Diff**	**Std. Error Difference**	**Lower**	**Upper**	**F**	**Sig.**
Pre-test	Experi	28	7.43	-2.213	.032	-1.095	.495	-2.091	-.100	2.694	.107
	Control	21	8.52	-2.147	.038	-1.095	.510	-2.128	-.062		
Post-test	Experi	28	19.96	5.588	.000	8.821	1.579	5.646	11.997	.385	.538
	Control	21	11.14	5.475	.000	8.821	1.611	5.564	12.079		

During the comparison of independent mean of pre-test and post-test score, independent t-test was used to determine whether there is a statistically significant difference between experimental and control groups as presented in the Table4.7. IIMs and 5E constructivist teaching method were used for Students in the experimental group and traditional teaching method was used for students in control group, where in constructing the deep understanding the acids and bases concepts. As showed in table4.7., the experimental group showed mean increase ranging from 7.43 to 19.96 in their level of acids and bases concepts understanding from pre-test to post-test scores. In this group $t(27) = 2.213$, $p = 0.03$; $(p > \alpha)$ this means that $0.03 < 0.05$ at $\alpha = 0.05$.

However, the control group showed a mean increase ranging from 8.8 to 11.14 in their level of acid and base concepts deep understanding from pre-test to post-test score and $t(20)=2.147$, $p=0.04$; $(p>\alpha)$ this means that $0.04 < 0.05$ at $\alpha = 0.05$. Therefore, experimental group

shows a mean difference of 12.53 whereas the change in the control group the mean difference is 2.62 points on the acid and base understanding of concepts test. Even there was an increase in understanding level of both groups experimental and control. The control group students could not score as many scores as the experimental group mean score on pre-test compared.

Experimental groups reflects a stronger mean significant effectiveness of IIMs in 5E instructional model of constructivist approach on students understanding compared to effectiveness of traditional teaching method without the use of IIMs. Therefore, the result of this study showed that the experimental group students gained more understanding of acid and base concepts than the control group students. The pre-test and post-test comparison of students in experimental group use of IIMs in 5E instructional model of constructivist approach to learn acids and bases concepts to indicate that higher mean difference between pre-test and post-test results were observed in favor of post-test. This implies that, students in experimental group shown significant changes in minimizing of misconceptions in acid and base topic.

Hypothesis: Data in the table4.6, the data showed that, there is a significant mean effect of IIMs and 5E learning cycle model of constructivist approach on students' understanding of acids and bases concepts of chemistry. $p = 0.000$; $(p < \alpha)$ this means that $0.000 < 0.05$ at $\alpha = 0.05$. The alternative hypothesis therefore was accepted, indicating that there was a significance difference in the mean achievement score of acids and base topic taught with Improvised instructional materials than those in the control group because there is a great different in mean score between control and experimental group.

4.5. Results obtained from informal classroom assessment

In addition to the pre-test and post-test, the researcher also conducted open-ended informal assessment questions for both experimental and control groups at the beginning and end of the implementation period used as pre and post classroom conversations on acid and base concepts. Before the lesson designed intervention, that means IIMs and 5E instructional model of constructivist approach for experimental group and traditional instructional teaching method without IIMs for control group. The researcher identified students' alternative conceptions on acids and bases concepts about the meaning of acid and base, properties of acid and base, example of acids and bases, formation of salt from acid and base mixture by using open ended pre-informal classroom assessment questions.

During and after the lesson implementation period, open ended questions were administered as pre-post informal classroom assessment (students' conversations) was conducted to gain detailed data on students understanding of acids and bases concepts. Pre-informal classroom assessments served as an order to determine what prior understanding of students already had on these concepts. The purpose of the post informal classroom assessment was to determine the effectiveness of IIMs and 5E instructional model of constructivist approach on students' conceptual understanding changes in acid and base concepts.

Students from experimental group and control group were asked by the researcher the concepts orally and students were asked to answer the questions orally and by focusing from the given IIMs on the desks. Students were asked such questions and to answer orally. (*What is an acid? What are the examples of acids? Mention the properties of acids, where can we find acids, what is a base? What are the properties of base? Mention example of base, what is the test of acid and base? How do we know if this is an acid or base? If acid and base are mixed together what would be the product? Why acids and bases in the laboratories are not advisable to be test? What is the test of the milk left to ferment? Which acid does it contain? What is the name of the acid found in our stomach? And how important is it? What is the PH of water people used for drinking?).* All these questions were used to expose students misconceptions on the topic that relate to acid and base concepts before lesson implementation as pre-informal classroom assessment and what conceptual understanding changed occurred after lesson implementation as post-informal classroom assessment during classroom conversations.

Pre-informal classroom assessments results; students answered on acids and bases concepts before lesson design intervention that is IIMs and 5E instructional model of constructivist approach for experimental group and traditional teaching instructional method for the control group. There were questions that the researcher used for the students to answer orally or write in their notes books and present their solutions to the class. Before the implementation period, most students in both control and experimental group ideas on these questions about acids and bases concepts; most students are giving the abbreviations of acid and base, they can't identify which substance contain contents of acid or base, they also thought that acids are only found in the chemical laboratory while the base can be found in plants because of the plants stalk which in other books the leave stalk is called a base. Other students responded by saying that '*'I don't know about acid and base*'' also there some students in the class who didn't spoke anything about acid and base concepts. Therefore, in these questions asked by the researcher, both the

experimental and control students had a number of difficulties of understanding of the acid and base concepts.

From the above questions asked by the researcher, a numerous of students misconception are noted, they are as follows;

Tab4. 7. Students misconceptions during pre-informal classroom assessments;

Content	***Misconceptions on acid***	***Misconceptions on base***
Meaning	• *Acid mean, Acquire Immune deficiency,* • *we use acids in laboratory only.*	• *Base is a substance with a very sweet test* • *Drinking water is base,*
Properties	• *Acid has a PH greater 7 because it has a better test,* • *It change litmus paper blue, cannot be test.* • *Cannot be touch by a bear hand* • *It is found in chemical laboratory only.* • *Acids reach with base to form acid rain.* • *It test better, has bad test,*	• *Has a basic test sweet or sour,* • *It change litmus paper red,* • *A base has a PH less than 7,* • *water has 1 PH,* • *Found in plants only.* • *A base react with acid to form acid and base* • *It test sweet, has nice test,*
Examples	• *Salt, rainwater, hands soap, baking powder, ash, urines,*	• *Mangoes, lemons, oranges, drinking water, all soft drinks,*

The results showed that both experimental and control groups students had a common misconceptions on the acids and base topic.

Teaching Strategy; based on the students common misconceptions that were obtained from the pre-informal classroom assessment questions on acids and bases concepts, the researcher leads to construct strategy to eliminate the students misunderstanding on acid and base content by using the IIMs and 5E instructional model of constructivist approach for experimental students that compared to the traditional teaching instructional for control students. Therefore, the descriptions of classroom activities for both experimental and control groups are as follows;

Experimental group teaching strategy; during the course instruction implementation, the experimental group students received the lesson with IIMs and 5E instructional model of constructivist approach (5E learning cycle) which involved hand-on and mind-on activities to

recall prior knowledge which it help in increasing the students curiosity, engage students to learn, provide them to explore the concepts and explain their understanding, also applying their knowledge in the new situation and evaluate students understanding on the topic concepts. The instruction followed five phases designed based on the constructivist views in 5E learning cycle model (Engage, Explore, Explain, Elaborate and Evaluate) was used to implement on acid and base contents. The IIMs and 5E learning cycle model was appropriate guide for use in the lesson designed. The activities involved in each phases of learning cycle are as follows;

Engage phase; in this first phase of the learning cycle, the researcher captured the students interest on the lesson by showing various fruits, and substances and asked different questions. (*What is an acid? What are the examples of acids? Mention the properties of acids, where can we find acids, what is a base? What are the properties of base? Mention example of base, what is the test of acid and base? How do we know if this is an acid or base? If acid and base are mixed together what would be the product? Why acids and bases in the laboratories are not advisable to be test? What is the test of the milk left to ferment? Which acid does it contain? What is the name of the acid found in our stomach? And how important is it? What is the PH of water people used for drinking? How do you describe an acid and base? Give some examples of acids and bases that have encountered in your everyday life. List sour and bitter foods which you had tested. Achol has prepared milk for her child, after some few days the test of the milk change to sour. Does the test of milk containing an acid and base? What kind of acid or base is the sour milk Contain? What is the colour milk at that kind of test? Name the acid that is found in the stomach. Without using indicator, how could you test whether the food is an acid or base? Why should you do this with any substance other than food? Is sodium (kombo) an acid or base? Explain. If a bee bit someone, why is it pain too much? How do you reduce that pain from bee bite?)*

All these questions aimed to connect the topic with students daily life activities and elicit students prior knowledge, students asked themselves question; the researcher had an opportunities to assess students prior understanding and identify possible misconceptions on acid and base concepts. Students were mentioning about the acid and base terminologies which are used in the topic like, acid, base, alkali, reaction, litmus paper, indicator, neutralization, products. The students-centred phase should be motivational period that can be a desire to learn more about acid

and base concepts. The researcher didn't present the correct answers of these questions but he only asked more questions to expand their prior ideas.

Explore Phase; following an engagement phase, explore phase promote a mental focus students on concepts. Students used hand-on activities by using the provided fruits and substances, guide student in inquiry, before any formal explanation of the terms, definitions of the concepts are discussed or explained by the students. Students formed small groups of five to six students and developed an indicator from boiled onion juice to explore about acid and bases from the given fruits and substances. The researcher encourage them to work together without direct instruction by asking probing questions to redirect the students , questions like, *why you are allowed to test citrus acids from the fruits but not allowed to test acids in the chemical laboratories? Why sour foods are important in human bodies? Acid + base ---------->*

In all the activities of exploration phase students were encouraged to work in cooperation learning environment without direct instructions from the teacher. Science teacher acted as a facilitator of the students' discussion and investigation as shown in figure4.1, below

F*ig6.* *Students were in exploring phase during the lesson*

Explain phase; the explanation phase is a mind-on activities which is a part of the 5E lesson cycle model that follows the exploration phase. Before the teacher explanation, the students had an opportunity to express their findings (own explanations) and ideas on acids and bases concepts. The explanation phase students to describe their understanding and posed

questions about the concepts. This is teacher-directed and guided by the students' prior experiences during the exploration phase. Thus, the primary part of the explanation phase is a time for the teacher to serve as a facilitator and asked the students to describe and discuss their exploration learning experiences. Here the students' classifications of the substances and fruits were based on acid, base and neutral. Some of the students were confused in sorting the IIMs.

At this point, students were asked to present which substances based on acids, base, base and neutral. The researcher introduced scientific information in a direct manner. This phase includes clarification of the students' misconceptions that they have emerged during the engagement or exploration phase.

Elaborate phase; in this phase, students related the concepts of acid bases on their daily life foods at their homes. The activities in this phase of the learning cycle should encourage students to apply their new understanding of the acid and base concepts. Students were encouraged to check on their understanding with group members, the goal of this phase is to help and develop students understanding of the topic concepts. In elaboration activities, students observed the examples of acids and bases, test citrus fruits, ash, different juice by their tongues as shown in figure4.2, below.

Fig7. Students were in elaborated phased during lesson

Evaluation phase; the researcher here assessed the students understanding by asking various open-ended questions and others done as a project such as (what *is an acid and base? Give some examples of acid and base that you have encountered in your everyday life. Achol has prepared milk for her child, after some few days the test of the milk change to sour. Is the test of the milk containing an acid or base? What kind of acid or base is the sour milk contain? What is*

the colour milk at the kind of test? Name the acid that is found in the stomach. Without using an indicator, how could you test whether the food is an acid or base? Why should you do this with any substance other than food? Is sodium (kombo) an acid or base? Explain, If a bee bit someone, why is it pain too much? How do you reduce that pain from the bee bite? Why the test of a red paper is bitter? How do you reduce the bitterness of the test of the red paper? Explain) students have answered these questions using the evidence from previous experiences from (Engage, Explore, Explain, Elaborate phases).

Control group teaching strategy; during the course of instruction the traditional teaching method was used to my students in control group. The researcher started the lesson by introducing and explaining the topic that was taught. Acid and base, (meaning of acids and base, the properties of acids and bases, the examples of acids and bases, how to test acids and bases contents, the reaction of acids and bases). All the subtopics of acids and base were explained by the teacher, IIMs were not used for learning. Students were following teachers' instructions, without allowing time for students to reflect on the contents presented by the teacher, related it to previous knowledge or applied it to the real life situation. Students followed teachers' instructions, explanations, and activities suggested in the science textbook. Therefore, in traditional teaching approach students were passive involvement in these lessons.

Post informal classroom assessment results; after the lessons implemented by the above teaching methods and materials; IIMs in 5E instructional model of constructivist approach for experimental group and traditional teaching method for the control group. Post informal classroom assessment questions were asked to both groups of students at the end of lesson implementation period in order to measures students' conceptual understanding changes on acids and bases concepts.

Experimental group's students changed on the answering questions about acid and base topic. These ideas basically developed by using 5E learning cycle phases, during engage phase, the researcher asked questions and showed the IIMs of acids and bases, explore phase, students' observed the IIMs, Explain phase, students here explained the concepts that observed from the hand-on activities of the exploration phase. In the Elaboration phase, students related the concepts of acid and base to their daily foods. At Evaluation phase, the researcher asked the conceptual questions and project problems on the acid and base contents. These all students'

activities in each phase were important to change students' conceptual understanding on acid and base concepts. These conceptual understanding changes of the experimental group students on the concepts of acid and base lesson were developed using the IIM in 5E phases of constructivist instructional model.

In summary, during the engagement phase, it captured students' interest by showing the real fruits and substances then questions asked. Explore phase promote a mental focus students on the concepts students did hand-on activities by using the fruits and substances. Students too developed an indicator from red onion juice by boiling to test for acid, base and neutral substances. Explain phase, is a mind-on activity that follows the exploration phase. Before, the researcher explained the concepts; the students had an opportunity to express their own explanations and ideas on acid and base concepts. The explanation phase students to describe their understanding and posed questions about the topic. At elaboration phase, students related the concept to their daily life activities and foods. Students compare the test of the substances and foods. At the evaluation phase, the researcher asked the open-ended questions that related to the topic as seen in 5E learning cycle model lesson plan.

Therefore, students in experimental group captured more conceptual understanding on the concepts. The researcher asked these questions for the control group students, most of them answered these questions but don't describe the scientific information. The students here answered knowledge questions but didn't answer reasoning questions because they followed the teacher explanation and demonstrations of the content without allowing an opportunity to work in group and present their ideas. The conceptual understanding changes for experimental group students had developed by IIMs and 5E learning cycle model, students used hand-on activities by using the real materials IIMs. Students observed and discussed the concepts of acids and bases and explain their understanding on the concepts, also they related the concepts to their daily life foods. Whereas, the control group students had answered these questions by memorizing from the teachers' explanation, most students answered these questions without detailed explanations of the concepts.

Results obtained from classroom observation

Question2. What is learners' observation on use 5E constructivist approach and improvised instructional materials?

Classroom observation was also used to evaluate several aspects of lesson presentation with the regard to students roles on the IIMs and 5E instructional model of the constructivist approach and traditional instructional on acid and base concepts. Therefore, during the intervention period, the researcher did self-observation on the students' classroom activities based on the observational checklist (as seen in Appendix B)

4.6.1. Observation in Experimental group classroom

In experimental group, the teacher observed that the overall activities of the students participated and interaction with the teaching material (IIMs) and Interaction among students themselves in groups. Students' interaction when taught with IIMs and the new methodology. By the use of IIMs and 5E constructivist approach, the students have the ability to answer conceptual questions and related the concepts to the daily life experiences. IIMs and 5E constructivist approach implementation, the teacher observed the participation of students in each contents of the acid and base lesson. Students participated highly, they raised their hands consistent and presented the concepts of acid and base, i.e. description of acid and base and the examples, properties of acid and base and the reaction of aid and base. The use of the IIMs and 5E constructivist approach in acid and base concepts had a positive effect on students understanding and interest to actively engage in the learning process as shown in figure8 below.

Fig8. *Students' active interaction in the classroom*

When the researcher observed the students interaction with the teaching materials in acid and base topic implemented by the use of IIMs most students used the appropriate teaching materials that related to the topic of the lesson. In all of the lessons taught learners were excessively allowed to interact with the IIMs. The researcher observed the students interact with each other; they had greatly interacted among the groups in all of the acid and base lessons that were implemented during the intervention with IIMs and 5E constructivist approach. It was possible because learners were directly involved in the group discussion during the exploration phase and the researcher only served to facilitate the students. The acid and base concepts lessons were characterized by high involvement of the students within the groups and encouraged collaboration learning. Various forms of thoughtful discussions and dialogues among the group of students were notice by the researcher. The examiner also observed the students interactions when taught with IIMs during the 5E instructional model of constructivist approach, the learning cycle consist of five phases, Engage, Explore, Explain, Elaborate and Evaluation phase.

During the implementation of these IIMs and the new methodology on acid and base concepts of chemistry, the teacher observed the students interactions in each phase. When he observed the first phase of the learning cycle, students engage by teaching with IIMs. When the researcher observed the explore phase, the students involved in hand-on activities during these activities and they have time to observe the IIMs and also identify them as acids, bases and neutral. Explain phase, when the researcher observed the students activities in this phase, they explained the concepts related to acid and base topic. Students have connected in their explanation to experiences in the engagement and exploration phases of the instructional model. During the Elaborate phase, the teacher observed the students' interest and students related the concepts in their daily life foods and substances. Students' use of IIMs has helped them to get information from each other, printed materials and experiences. The students were very happy because every activity in the topic that exactly related to their foods at their homes. Evaluate phase; the teacher observed that, the students have interest to answer the conceptual questions that related to acid and base concepts written on the chalk board or asked orally. So the students answered all the questions with interest during the evaluation phase.

In the lesson observation, the majority of the experimental group students were able to answer conceptual questions and related concepts in their daily experiences. During the intervention period, the teacher asked students conceptual questions which related to the acid and base concepts.

4.6.2. Observation in Control group classroom

During the intervention, the researcher also observed the role of students in control group. In this group of the students, they were passively received information from the teacher. Students didn't actively participated, interacted with any materials (IIMs) even in groups and them unable to answer conceptual questions. In the lessons, the idea flowed from the teacher to the learners (teacher-centred). They took on a passive role in the classroom, used their notes in the notes books and science textbooks.

The classroom observation result indicated that students in the experimental group who were taught by IIMs and 5E constructivist approach actively involved in the classroom that compared with the students in the control group who were taught by traditional instructional approach. In general from the observation, students comment the use of IIMs and 5E instructional model have many processes involved in scientific inquiry that mean an excellent way of the students to evaluate their understanding in the topic content. Students in experimental group gained their interest more and keep them engaged in activities of the topic. Students in experimental group used comment on use of IIMs in 5E instructional model of constructivist approach such as (*'' I like the way our new science teacher is teaching us'' it helped me engaged to know about acids and bases'' ''I am happy with our science teacher'' ''I can now talk in front of my classmates, before I fear my friends in the class to talk in English'').* Therefore, the results from researcher observation indicated that experimental group students actively involved in the classroom and favored the uses of IIMs and 5E learning cycle teaching of constructivist approach.

CHAPTER FIVE

5. DISCUSSION AND SUGGESTIONS OF THE RESULTS

This chapter involves a discussion that obtained from the results in relation to the existing literature and suggestions needs to indicate the practical significance that were obtained in this study.

5.1. Discussion of the Results

The main purpose of this study was investigating the effects of 5E constructivist approach and improvised Instructional materials on the teaching of acids and bases concepts of chemistry. To see the effects, IIMs and 5E learning model of constructivist approach were used in comparison to the traditional instructional teaching.

Before the lesson implementation, both experimental and control group students took pre-test on the acids and bases concepts. The mean score was checked by descriptive statistics and independent sample t-test as presented in table 4.6 and table4.7.0, the pre-test results indicated that, students prior knowledge of understanding of acid and base concepts were not different across the control and experimental group with a small mean difference (1.09) and the mean of the control group is greater than the experimental group. This statistically, insignificant t-test results also supported the idea that the groups were assumed to be equal in terms of prior understanding of acids and bases concepts before applying the intervention. The previous researchers found that prior knowledge has a great influence on students understanding of science concepts (Duschl & Gitomer, 1991; Tekkaya & Ozkan, 2001). They emphasized that the prior knowledge play a critical role in understanding, construction, conducting study with the group had similar prior understanding would be better for the quasi experimental research.

After two weeks of implementation period with the IIMs for experimental group and traditional teaching without IIMs for control group, both experimental and control groups took post-test on student's conceptual understanding and acid and base concepts. When the scores was checked by descriptive statistics as shown in table 4.6, and the independents sample t-test as seen in table4.7, the results of the post-test indicated that, statistically, a significant difference is found about the effectiveness of IIMs in 5Elearning model of teaching has improved students understanding and constructing of scientific knowledge in acid and base topic compare to the traditional teaching approach without the use of IIMs. As presented in the comparative tables

4.3, and table 4.4, it also showed that, experimental group students have a better understanding of acid and base concepts after the intervention.

5E Learning cycle instruction significantly improve the students conceptual understanding in comparison with the traditional instruction in the topic concepts (Kaynar and Tekkaya, 2009). In pre-test, the researcher also conducted pre-informal classroom observation open-ended questions for both groups before the lesson implementation. The pre-informal classroom assessment results indicated also that, both experimental group students and control group had a lot of common misconceptions in acid and base topic. The researcher also conducted post-informal classroom assessment on open-ended questions for both groups after the intervention period on acid and base concepts.

The post-informal assessment results have indicated that, conceptual understanding difference among the experimental and control group in the topic content. Students who were taught using IIMs in 5E learning cycle model of constructivist approach performed well than those in control group who were attended their lessons with traditional teaching method. The comparison of the students scored between experimental and control groups on post conversation questions, experimental group students had better improvement in acid and base topic conceptual understanding after the intervention of the tool.

Experimental group students answered the post-informal assessment questions by explaining the concepts. The results implied that IIMs are more effective in deep understanding of acid and base concepts compare to the students who were taught with traditional instruction without IIMs. The result is in line with Aydin (2013), who stated that technologically supported mind mapping technique combined in 5E learning cycle constructivist approach, the activities that provide the linkage among the concepts enhance better conceptual understanding and to students reasoning ability in acid and base concepts.

The hypothesis sought to find out if there was a significant difference between the academic performance of primary eight class in science taught Acids and bases with the improvised instructional materials and those taught without. This study showed that treatment was significance ($p=0.000$, $p<0.05$; the importance and significant role played by improvised instructional materials on students' academic performance, especially in chemistry. It had a positive influence in chemistry achievement. This was explained why a subject like chemistry

will require real objects and activities/experiments that can convert topic that seem imaginary to concrete for the students understanding. It was therefore observed that improvised instructional materials made teaching and learning real. It allowed students to interact better in their lesson. It made students to use their intellectual ability during the learning and teaching process. This finding agreed with that of Nja and Kalu (2013), whose study used, showed that kitchen resources (improvisation) enhanced the performance and retention level of high and low reasoning ability of the students exposed to kitchen resources during the teaching to Thermochemistry. According to Ogwu (2005) chemical principles and processes which relate to local activities place pupils on familiar grounds, help to maintain interest in the subject and create scientific awareness. Omiko and Oketa (2017) investigated the effect of improvised and standard instructional materials on students taught chemistry using improvised materials performed better than those taught without them.

Classroom observation results showed that, students in experimental group taught by IIMs highly participated in lesson interacted with teaching materials and groups, to answer conceptual questions and related the concepts to their daily activities that compared with the students in control group who were taught without any IIMs. Observation have been stated by Adula and Kassahum (2010), constructivist teaching approach has conception that students learn for understanding of natural science when they learn using teaching materials that the expertise in the concerned area are using and perform the real activities and also delivery of materials and activities in learning science from learners helps them on test their ideas and related the theoretical to practical part of the lesson with students discussions and explanations of the concepts.

5.2. Suggestions of the study

Before the intervention, the methods used by the science teachers in teaching and learning of lessons concepts in grade eight classrooms that was traditional teaching method without IIMs.

Based on the findings of this study, IIMs and 5E learning cycle model of constructivist approach were found to be more effective in teaching acid and base concepts than the traditional teaching method. The suggestion here is that, science teachers need to develop themselves knowledge of using of IIMs and 5E constructivist approach in chemistry classroom in large science classes. The approach requires that the learners have access to IIMs, science models,

science textbooks and teacher guide since the students in the class are actively construct knowledge and they were encouraged to explore the real world around them, discover knowledge, reflect and think critical.

Another suggestion is that, the students should be encouraged in an active process of learning such as hand-on, mind-on and discovery. This type of approach of teaching is a learner-centered that allowed the students to search for knowledge and the teachers act as a facilitator or guidance.

The more the teachers used the materials, the easier it became for them to carry out learner-centred investigations in the class. The 5E constructivist approach that requires practice on use of learner-centered investigative practical work should be integrated into both the in-service and pre-service teacher trainings.

For the students to become good thinkers in chemistry, teachers must be good thinkers themselves (Aksela 2007). This implies that the teachers should develop investigative abilities and critical thinking in order to guide learners through conducting investigations. Use of investigative learner-centred investigative activities should be integrated in to primary and secondary school curricula so that teachers are able to appreciate and invest in the use of such materials.

CHAPTER SIX

6. Summary, Conclusion and Recommendations

6.0. Introduction

This part concerns with the summary, conclusion, recommendation and the suggestion for further research as well as to wanted to answer the research questions that were proposed initially in the study.

6.1. Summary of the Study

This section deals with the summary of the most important points in the study that includes how effective are the IIMs and 5E constructivist methods used by the science teacher in teaching/learning of acids and base concepts of chemistry.

In order to guide this study the researcher forwarded the following questions. How helpful are improvised instructional materials & 5E constructivist approach on teaching/learning acids and bases toward learners' performance? What is learners' observation on use 5E constructivist approach and improvised instructional materials? And with a hypothesis, there is statistical significant difference in students' conceptual understanding in chemistry concepts of acids and bases between experimental and control group students. The researcher came up with specific objectives; the first is to observe the values of improvised instructional materials (IIMS) on primary eight-science pupils' academic achievement and performance. The second is to inspect the Science performance of Students through the use of 5E constructivist approach improvised instructional materials. The last is to examine the effects of 5E constructivist approach in teaching/learning of acids and Bases concepts of chemistry.

In this study, the research design was quasi-experimental and descriptive in the nature that aligned with the qualitative approach and the sampling techniques that were applied both the purposive and simple random sampling were used because of the purpose we had at hand and we were having an objectives to achieve at the end of this study. Two sections (N=49) were selected and students were assigned as experimental and control groups. Students' conceptual understandings were assessed by using open-ended questions on acid and base content. Pre-test, post-test, informal assessment and observation checklist were used to determine the effectiveness of IIMs in 5E learning cycle model of constructivist approach on students conceptual understanding change in the concepts of acids and bases.

The random sampling method of selection was applied for minimization of biasness, maximization of the reliability and validity of the data. And the collected data from pre-test and post-test were analyzed quantitatively through comparative of percentages, descriptive statistics and independent sample t-test and data obtained from classroom observation and pre-informal classroom assessment were analyzed and qualitatively due to reason that they could interpret, explained and formulated for the decision making. The treatment covered the definitions of acid and base, properties of acids and bases, examples of acids and bases and the reaction of acids and based

The summary also includes the analysis of each of the items regarding the acids and bases by using IIMs and 5E constructivist approach on acid and base topic. At the beginning of those topics, both experimental and control group students used with the structure (open-ended questions) on primary eight acid and base topic understanding pre-test that covers the questions related to the topic. The conducted analyses of independent sample t-test, the results revealed that, there is significant difference between control and experimental group based on their pre-test scores.

Qn1. How helpful are improvised instructional materials & 5E constructivist approach on teaching/learning acids and bases toward learners' performance?

During the course of instructions, experimental group students received the IIMs in 5E learning cycle model which involves hand-on and mid-on activities. The instructions followed the five phases designed based on the constructivist views in the learning; Engage to learn, explore the acids and bases concepts by the students, Explain their understanding and experiences, Elaborate the concepts by applied their knowledge in new situations and Evaluate students understanding by asking conceptual questions. From the control group of students, they received lessons by using traditional teaching instructions based on teachers' introduction, explanations and summarization, students in this group followed teacher introduction, explanation and demonstrations and activities suggested in the textbooks.

After the end of acid and base topic or after two weeks of the implementation periods, students in both groups were examined by post-test to determine the changes and the difference among the groups in terms of understanding of acid and base concepts. The independent sample t-test analysis of post-test results showed that, there is a significant difference between the post-test of the students taught using IIMs in 5E learning instructional model of constructivist

approach and those taught by traditional teaching instructional or experimental group had better conceptual understanding of acids and bases concepts after the intervention period.

The results of this study revealed that, the experimental group students 'taught with IIMs in 5E learning cycle model of constructivist approach have shown higher results in the post test and more correct response or answers in the post informal classroom assessment (classroom conversations) and also participated highly in lesson compared to the control group students taught with traditional teaching instructions.

In addition to the quantitative results, the qualitative results obtained from post informal classroom assessment (classroom conversations) also provide evidence supporting those findings that IIMs and 5E constructivist approach group students constructed more conceptual understanding of acids and bases concepts of chemistry.

Qn2. What is learners' observation on use 5E constructivist approach and improvised instructional materials?

The results obtained from classroom observation exercise indicated that, students in experimental group taught by IIMs in 5E learning cycle model of constructivist approach highly participated in the lesson, interacted with the group members, have interest in learning and interact with the IIMs, to answer conceptual questions and related the concepts to their daily activities that compared to the control group students taught by traditional teaching instruction.

The findings indicated that both the acid and base concepts were not exercised well by the science teachers and most can't plan for scheme of work and lesson plan, they just come from their homes and entered to the class without knowing the objectives of the lesson and what the learners wanted to learn in acid and base topic.

Furthermore, the finding showed that the schools has not school garden to obtained other teaching in it, so teachers found it difficult to improvised in the class because teachers are not well motivated. .

It was also observed that the newly learned concepts were constructed in the mind correctly by removing the concepts errors existing in their pre information. The finding revealed that IIMs and 5E constructivist approach were not successfully used in the teaching and learning of acid and base concepts in primary eight classrooms

The science teacher used traditional teaching method without Scheme of work and lesson was used in the teaching and learning of acid and base topic by the science teachers of south

Sudan. It was indeed observed that students are motivated and excited in creativity and use of improvised instructional materials.

Hypothesis

There was a strong significant difference appeared in pre-test and post-test when both control and experimental group students are taught new scientific concepts with IIMs and 5E constructivist approach.

6.2. Recommendations of the study

As clearly witness from the application of the IIMs and 5E learning cycle model of constructivist approach in chemistry classroom, the following recommendations are mandatory for the conceptual understanding of chemistry concepts acid and base.

1. The PTA and government should motivate teachers and go into counterpart funding for the provision of standard instructional materials to the schools.
2. Teachers should be train on how to improvise alternatives to real objects to enhance teaching and learning.
3. The teachers should make use of only instructional materials that are relevant to their lesson content.
4. Learners should be actively involved in sourcing for materials in school compound or at their homes.
5. Science teachers should develop and use learner centred strategies during chemistry lesson class to ensure that learners are engaged in the designer of plans and procedures for their 5E learning cycle model.
6. The science teachers should take their students to places of interest to enable them see things in their natural ways.

6.3. Conclusion

From the results of this study, it is possible to conclude that the IIMs and 5E learning cycle model of constructivist approach is more effective teaching instructional materials on improving the students' conceptual understanding of acid and base concepts compared to the traditional teaching approach without IIMs.

Suggestion of further research

Improvised instructional materials IIMs and 5E constructivist approach play a very important role in teaching/learning of acids and bases concepts of chemistry in secondary school classes.

Action plan

Splitting of time (time break down of this study)

Over all, the researcher shall apply this partitioning of time schedule to accompany his task study under investigation.

S/NO	Particulars/details	Achievement time
01	Visiting the education office in Munuki block and school administration seeking for authorization letter and a go ahead.	30/November/2020
02	Carrying out lesson interventions (data collection)	07 – 19/December/2020
03	Analysis of the data	04 January to 21 May /2021
04	Writing the whole research report	04 January to 12 June/2021

Budget breakdown

S/no	Details	Folio	Rate In Birr	Amount In Birr
1	Stationary	2	1,000	**2,000**
2	Secretarial services	1	5,000	**5,000**
3	Transport	1	10,000	**10,000**
4	Feeding	1	3,000	**3,000**
5	Purchase of instructional materials		5,000	**5,000**
7	**Total amount for the whole expenses**			**25,000 Birr**

REFERENCE

Adeogun, A. A. (2001). The principal and the financial management of public secondary schools in Osun State. *Journal of educational system and development*, *5*(1), 1-10.

Adeyemi, S. B. (2012). Developing Critical Thinking Skills in Students: A Mandate for Higher Education in Nigeria. *European Journal of Educational Research*, *1*(2), 155-161.

Afolabi, O. A. (2013). Stereotypes against women: how do subordinates perceive the job performance and level of achievement of their leaders?. *Gender and Behaviour*, *11*(2), 5698-5706.

Ahmed, A. M. (2008). Improvisation of instructional materials for the teaching of Biology, an important innovation in the Nigerian educsational system, *Pristine Journal*, *50*, 1-7.

Aina, K. J. (2013). Instructional materials and improvisation in physics class: Implications for teaching and learning. *Computer*, *2*(20), 8.

Akani, O., & Oketa, i. o. effect of improvised and standard instructional materials on student's achievement in chemistry in secondary schools.

Akerson, V. L., Flick, L. B., & Lederman, N. G. (2000). The influence of primary children's ideas in science on teaching practice. *Journal of Research in Science Teaching: The Official Journal of the National Association for Research in Science Teaching*, *37*(4), 363-385.

Anderson, D. (1999). *The development of science concepts emergent from science museum and post-visit activity experiences: Students' construction of knowledge* (Doctoral dissertation, Queensland University of Technology).

Artdej, R., Ratanaroutai, T., Coll, R. K., & Thongpanchang, T. (2010). Thai Grade 11 students' alternative conceptions for acid–base chemistry. *Research in Science & Technological Education*, *28*(2), 167-183.

Ayua, G. A. (2011). Teachers' awareness and level of improvisation of primary science instructional materials in primary schools in Makurdi metropolis. *Benue State University Journal of Education*, *11*, 44-50.

Bajaj, S. (2017). A Study of Impact of Laboratory on Academic Performance of 9th Class Students in Science Subject. *The International Journal of Indian Psychology*, *4*(3), 104-111.

Blumenfeld, P. C., Marx, R. W., Patrick, H., Krajcik, J., & Soloway, E. (1997). Teaching for understanding. In *International handbook of teachers and teaching* (pp. 819-878). Springer, Dordrecht

Bonwell, C. C., & Eison, J. A. (1991). *Active Learning: Creating Excitement in the Classroom. 1991 ASHE-ERIC Higher Education Reports*. ERIC Clearinghouse on Higher Education, The George Washington University, One Dupont Circle, Suite 630, Washington, DC 20036-1183.

Brooks, J. G., & Brooks, M. G. (1993). In search of understanding: the case for constructivist classrooms. Alexandria, VA: Association for Supervision and Curriculum Development. Bybee, RW (2003). Why the seven E's. *Educational foundations: An anthology of critical readings*, 184-194

Bybee, R. W., Taylor, J. A., Gardner, A., Van Scotter, P., Powell, J. C., Westbrook, A., & Landes, N. (2006). The BSCS 5E instructional model: Origins and effectiveness. *Colorado Springs, Co: BSCS*, *5*, 88-98.

Carin, A. A., & Bass, J. E. (2001). *Methods for teaching science as inquiry*. Prentice Hall.

Chiu, M. H., & Lin, J. W. (2005). Promoting fourth graders' conceptual change of their understanding of electric current via multiple analogies. *Journal of Research in Science Teaching: The Official Journal of the National Association for Research in Science Teaching*, *42*(4), 429-464.

Chonjo, P. N. (2018). The quality of education in Tanzanian primary schools: An assessment of physical facilities and teaching learning materials. *Utafiti Journal*, *1*(1).

Claxton, C. S., & Murrell, P. H. (1987). *Learning Styles: Implications for Improving Educational Practices. ASHE-ERIC Higher Education Report No. 4, 1987*. Association for the Study of Higher Education, 1 Dupont Circle, Suite 630, Washington, DC 20036.

Clement, J. (1993). Using bridging analogies and anchoring intuitions to deal with students' preconceptions in physics. *Journal of research in science teaching*, *30*(10), 1241-1257

Cros, D., Maurin, M., Amouroux, R., Chastrette∗, M., Leber, J., & Fayol, M. (1986). Conceptions of first- year university students of the constituents of matter and the notions of acids and bases. *European journal of science education*, *8*(3), 305-313.

Demircioglu, G., Ayas, A., & Demircioglu, H. (2005). Conceptual change achieved through a new teaching program on acids and bases. *Chemistry Education Research and Practice*, *6*(1), 36-51.

Duschl, R. A., & Gitomer, D. H. (1991). Epistemological perspectives on conceptual change: Implications for educational practice. *Journal of research in science teaching*, *28*(9), 839-858.

Ergin, I. (2012). Constructivist approach based 5E model and usability instructional physics. *Latin-American Journal of Physics Education*, *6*(1), 14-20.

Esu, A. E. O., & Inyang-Abia, M. E. (2004). Social studies technologies, methods and media. *Port Harcourt, Nigeria: Double Diamond Publications*.

Gagné, E. D., & Middlebrooks, M. S. (1977). Encouraging generosity: A perspective from social learning theory and research. *The Elementary School Journal*, *77*(4), 281-291.

Gagné, M., & Deci, E. L. (2005). Self- determination theory and work motivation. *Journal of Organizational behavior*, *26*(4), 331-362.

Griffiths, A. K., (1994). A Critical Analysis and Synthesis of Research on Chemistry Misconceptions. In Schmidt, H.-J., (Ed.), Proceedings of the 1994 International Symposium Problem Solving and Misconceptions in Chemistry and Physics, the International Council of Associations for Science Education Publications, 70–99.

Hawk, T. F., & Shah, A. J. (2007). Using learning style instruments to enhance student learning. *Decision Sciences Journal of Innovative Education*, *5*(1), 1-19.

Hesse III, J. J., & Anderson, C. W. (1992). Students' conceptions of chemical change. *Journal of Research in science teaching*, *29*(3), 277-299.

Iji, C. O., Ogbole, P. O., & Uka, N. K. (2014). Effect of improvised instructional materials on students achievement in Geometry at the Upper Basic Education Level in Makurdi Metropolis, Benue State, Nigeria. *Educational Research and Reviews*, *9*(15), 504-509.

Juntunen, M., & Aksela, M. (2013). Life-cycle thinking in inquiry-based sustainability education–effects on students' attitudes towards chemistry and environmental literacy. *Center for Educational Policy Studies Journal*, *3*(2), 157-180.

Kimson, J. I., & Joy, J. O. Chemistry Games with Kitchen Resources and Students' Academic Performance in Electronic Configuration.

Kombo, D. K., & Tromp, D. L. (2006). Proposal and thesis writing: An introduction. *Nairobi: Paulines Publications Africa*, *5*(1), 814-30.

Kwame, t. w. j. (2018). Impact of instructional materials in the teaching and learning of chemistry in senior high schools in the Yilo robo and lower Manya Krobo municipalities

Lin, J. W., Chiu, M. H., & Liang, J. C. (2004, April). Exploring mental models and causes of students' misconceptions in acids and bases. In *National Association for Research in Science Teaching* (pp. 1-12).

Meyers, C., & Jones, T. B. (1993). *Promoting Active Learning. Strategies for the College Classroom*. Jossey-Bass Inc., Publishers, 350 Sansome Street, San Francisco, CA 94104.

Morrison, J. A., & Lederman, N. G. (2003). Science teachers' diagnosis and understanding of students' preconceptions. *Science education*, *87*(6), 849-867.

Mwangi, J. T. O., & Mwangi, J. T. O. (2016). *Effect of Chemistry Practicals on Students' Performance In Chemistry In Public Secondary Schools Of Machakos And Nairobi Counties In Kenya* (Doctoral dissertation, University Of Nairobi).

Mwiria, K., & Wamahiu, S. P. (1995). Issues in Educational Research in Africa Nairobi: East African Educational Publishers.

National Research Council. (1997). *Science teaching reconsidered: A handbook*. National Academies Press.

Nja, C. O., & Kalu, I. (2013). Kitchen resources classroom interaction and academics performance and retention in thermochemistry in Cross River State, Nigeria. *Journal of Education and Practice (IISTE)*, *4*(8), 169-172.

Novak, A. M., & Krajcik, J. S. (2006). Using technology to support inquiry in middle school science. In *Scientific inquiry and nature of science* (pp. 75-101). Springer, Dordrecht.

Novick, S., & Nussbaum, J. (1978). Junior high school pupils' understanding of the particulate nature of matter: an interview study. *Science education*, *62*(3), 273-81.

Obi, N. C., & Obi, J. J. (2019). Effect of improvised instructional materials on academic achievement of SS1 chemistry students in cross river State Nigeria. *IJAR*, *5*(7), 444-448.

Ogunlade, J. O., & Makinde, V. I. (2012). Attitude of teachers-in-training to teaching profession in the Nigerian tertiary institutions. *Journal of Research in Education and Society*, *3*(2), 95-100.

Onasanya, S. A., & Omosewo, E. O. (2011). Effect of improvised and standard instructional materials on secondary school students' academic performance in physics in Ilorin, Nigeria. *Singapore Journal of Scientific Research*, *1*(1), 68-76.

Posner, G. J., Strike, K. A., Hewson, P. W., & Gertzog, W. A. (1982). Accommodation of a scientific conception: Toward a theory of conceptual change. *Science education*, *66*(2), 211-227.

Ramel-Galima, L. V., Rivera, D. V., & Almanza, E. G. (2013). Cultural Sensitivity and Improvisation in Science Teaching: Using Indigenous, Local, and Available Materials in Teaching Chemistry. *International Journal of Science in Society*, *4*(2).

Ross, B., & Munby, H. (1991). Concept mapping and misconceptions: a study of high- school students' understandings of acids and bases. *International journal of science education*, *13*(1), 11-23.

Sandholtz, J. H., Ringstaff, C., & Dwyer, D. C. (1994). Student engagement: Views from technology-rich classrooms. *Document téléaccessible à l'adresse< http://www. apple. com/euro/pdfs/acot library/rpt21. pdf*.

Sandoval, W. A., & Reiser, B. J. (2004). Explanation- driven inquiry: Integrating conceptual and epistemic scaffolds for scientific inquiry. *Science education*, *88*(3), 345-372.

Sanger, M. N., & Osguthorpe, R. D. (2011). Teacher education, preservice teacher beliefs, and the moral work of teaching. *Teaching and teacher education*, *27*(3), 569-578.

Santoro, N., Reid, J. A., Crawford, L., & Simpson, L. (2011). Teaching Indigenous children: Listening to and learning from Indigenous teachers. *Australian Journal of Teacher Education*, *36*(10), 65-76.

Schneider, R. M., Krajcik, J., Marx, R. W., & Soloway, E. (2002). Performance of students in project- based science classrooms on a national measure of science achievement. *Journal of Research in Science Teaching: The Official Journal of the National Association for Research in Science Teaching*, *39*(5), 410-422.

Shepardson, D. P., & Britsch, S. J. (2001). Tools for assessing and teaching science in elementary and middle school. In *Assessment in Science* (pp. 119-147). Springer, Dordrecht.

Stavy, R. (1991). Using analogy to overcome misconceptions about conservation of matter. *Journal of research in science teaching*, *28*(4), 305-313.

Sumra, S., & Rajani, R. (2006, September). Secondary education in Tanzania: Key policy challenges. In *Proceedings of Norwegian Post-Primary Education Fund for Africa (NPEF) Seminar, Oslo, Norway* (pp. 13-14).

Tekkaya, C. (2002). Misconceptions as barrier to understanding biology. *Hacettepe Üniversitesi Eğitim Fakültesi Dergisi*, *23*(23).

Tobias, S. (1994). Interest, prior knowledge, and learning. *Review of educational Research*, *64*(1), 37-54.

Tytler, R., & Peterson, S. (2005). A longitudinal study of children's developing knowledge and reasoning in science. *Research in Science Education*, *35*(1), 63-98.

Uzoegwu, P. N. (2001). Availability of instructional materials for effective teaching and learning of English language in the universal basic education scheme. The Nigerian Universal Basic Education, Journal, 1(2), 205-206.

Wheeler, A. E., & Kass, H. (1978). Student Misconceptions in Chemical Equilibrium. *Science education*, *62*(2), 223-32.

Wilder, M., & Shuttleworth, P. (2005). Cell inquiry: A 5E learning cycle lesson. *Science Activities*, *41*(4), 37-43.

World Bank,(2012). *Education in South Sudan: Status and Challenges for a New System*. The World Bank.

Yerdelen-Damar, S., Boz, Y., & Aydın-Günbatar, S. (2017). Mediated effects of technology competencies and experiences on relations among attitudes towards technology use, technology ownership, and self-efficacy about technological pedagogical content knowledge. *Journal of Science Education and Technology*, *26*(4), 394-405.

Appendix A: Theoretical test

(This is a pre and post-test which is constructed by the researcher to examine the students understanding of acid and base)

Dear pupils,

The purpose of this achievement test is to examine your understanding of acid and bases. The results of the test will not be used to give you grade for promotion to another level; it is only for research intention.

Please, give due attention and respond to the questions honestly. I would like to pledge to you that your responses are kept confidential and will only be used for research purpose.

Group: …….Code:……

Answer all the questions each question is caring three marks (3 marks)

Qn1. From the collective fruits on the table i .e; Lemon, mango, orange etc, which one contains acid and base content? How do you know that the fruit is an acidic and basic? Explain your findings……
……
……

Qn2 .Four solutions are prepared and an indicator extracted from plants is added to the four – solutions. What is the effect of acids and bases on indicator?

Solution		**Colour Observed**	**Acid/base**
A	Lemon juice		
B	Ash solution		
C	Mango juice		
D	orange juice		

Qn3. You had prepared milk for family consumption, after some few days the test of the milk change to sour.

A. Is the test of the milk showing existence of an acid and base?
B. What kind of acid or base is the sour milk contained?
C. What is the color change on the litmus paper if it is dipped in the sour milk?

……
……
……

Qn4. Cooking green leaves, always sodium salt and (kombo) processed from ashes are added. Why? What is the test of the content before and after adding the substances in the cooking pot?

Reasons …… ……		
	Before	**After**
Test		

Qn5. How do you describe an acid and base? Give some examples of acids and base that you have encountered in your everyday life. List the examples of sour and bitter foods which you have ever tasted.

……
……
……

Qn6. Have you ever wondered about the origin of the saying, ‘’it is a bitter herbs (dawa murr) to swallow’’? Discuss and give a meaning to the saying.

……
……
……

Qn7. While taking bath, have you ever had soap in your mouth? How does it taste? Is the test acidic or basic, explain why?

……
……
……

Qn8. You are allowed to taste some acids like citric acid from home, but you are never allowed to taste any kind of acids in the laboratory. What is the reason?

……
……
……
……

Qn9. Add a drop of lemon juice on your tongue and try to identify its taste. Repeat your observation with orange juice. What is the taste of the two juices (bitter or sour)? Try to classify them as acid or base, depending on their taste. Share your experiences.

……
……
……

Appendix B: Observational checklist

The objective of this checklist is to get additional information about the impact of IIMs and 5E constructivist approach in teaching/learning of acid ad base concepts of chemistry. Your school is one of those that have been sampled for the study.

S/no	**Observation guidelines**	**Researchers' observations**
01	Participation of pupils on acids & base lessons	---------- ---------- ----------
02	Pupils interaction with the teaching materials IIMS in aids and base lessons	---------- ----------
03	Pupils interaction among themselves in the class	---------- ---------- ----------
04	Pupils interest when taught with IIMS in 5E constructivist approach	---------- ---------- ----------
05	The ability of the learners to answer conceptual questions and relate the concepts in to the daily life experience.	---------- ----------
06	Teachers interaction with the pupils in both experimental and control groups	---------- ---------- ----------

Appendix C: Intervention plan for both groups

The intention of this plan is to allocate a specific time for the intervention of the study on the acid ad base topic in science.

Intervention Program	Date	Section	Time	Lesson number	Lesson topic/test	The outcomes of the lesson topic acid & base
Before intervention	12/01/2021	CG	35 min	1	Pre-test	▪ Measuring students' prior knowledge or conception on precedent lessons covered
		EG	35 min	1	Pre- test	
During intervention	13/01/2021 to 15/01/2021	CG	35 minx2	2	Acid & base, properties	▪ Pupils understand the meaning of acid and bases
		EG	35 minx2	2	Acids & base, properties	
	18/01/2021	CG	35 min	1	Types of acids & bass	▪ Learners lists and mention types of acids and bases examples
		EG	35 min	1	Types of acids & bass	
	19/01/2021	CG	35 min	1	Uses of acids & bases sources	▪ Pupils understand the uses, the sources of acid, base and their effects on materials.
		EG	35 min	1	Uses of acids & bases sources	
After intervention	20/01/2021	CG	35 min	1	Post-test	▪ Measure students understanding of the concepts of acids and bases using two different instructional treatment achievement
		EG	35 min	1	Post-test	

NB:

CG= class eight Controlled group

EG= class eight Experimental group

Appendix D; Lesson Plan for experimental group

The objective of this lesson plan is to determine the effectiveness of IIMs and 5E constructivist approach in teaching/learning of acid ad base concepts of chemistry.

5E Constructivist approach Lesson Plan

Subject: Science **Date of lesson**: 07 to 18th /12/2020 **Year:** 2020

Pupils: male: …24…..**Female**:…...38..... **Total:**…62… **Class; Primary Eight** **Period**: Two weeks (260mins)

Title of Lesson: Acid and Base (Properties of matter)

Subject Content:

- Acid and Base

Key Vocabularies: acid, base, alkaline, strong acids, weak acids, strong base weak base, sour test, bitter test, organic acids, inorganic acids, neutralization, salts, PH scale, experiments saliva, laboratory, laboratory instruments, Apparatus, measurement techniques error, experiment solo, in pairs, or in teams, Litmus paper, Solution, acid-base indicator, improvised instructional materials, standardized instructional materials etc.

Specific Leaning Objectives:

By the end of this topic, learners should be able to;

1. Prepare universal indictor from plants materials and finding out the effects of indictor on acid and base.
2. To use the prepared litmus paper to establish a solution as a base or an acid based on the color change.
3. To use red onion juice to determine if a solution is an acid or base.
4. Determine the PH of known and unknown acids base using the PH paper design.
5. Gain insights about how household materials (improvised) give the same learning effect as the known standard materials in teaching acid and bases.
6. Recognized and name the examples, effects and properties of acid-bases in the food and fruits.
7. Construct a deep understanding of acid and base content.
8. Prepare acids, sodium (kombo) from citrus fruits and ashes.
9. Design and carry out one or more controlled experiments to investigate a simple question using some of the above equipment.
10. Recognize sources of experimental error arising from practical activities.
11. Discuss methods of compensating for experimental error (e.g., by repeating the same experiment).

12. Answer questions and carry out experiments solo or in pairs.

Safety

Follow appropriate safety laboratory rules and procedures during the experiments in the laboratory /science classroom.

Knowledge/skills for pupils

- Pupil should understand how to carry practical in the lab/class.

They should able to draw tables for findings.

Procedure

- This lesson is a guided inquiry lesson.
- The role of the science teacher is to facilitate the pupils constructing their own knowledge. this mean the teacher provides appropriate questions to start the pupils investigating, guides the pupils to appropriate observations that will help them gather needed evidence and selects applications of the knowledge constructed so that pupils will refine, correct and extend their knowledge.
- The pupils are responsible for constructing their own knowledge. In each activity below, we will suggest appropriate teaching/Learning questions given to the pupils.

Teachers Activities	**Time**	**Pupils Activities**
1. ENGAGE • The science teacher takes in account of ‘’Pupils` existing ideas when planning future learning experiences’’. • Create excitement and interest and talk provide an opportunity • Provoke curiosity and wonder for the teacher to assess pupils` • Give learners an unexpected result. Prior knowledge, including any • Generate discussion/debate alternative conceptions. • Raise questions • Create natural reasons to explore. • The teacher asks a range of reflection	5minutes each day (20x4=80 mins)	• The learners voluntarily answer • Pupils` writing, drawing, Discuss and talk provide an opportunity for the teacher to assess pupils prior knowledge, including any alternatives conceptions

questions to test student`s previous Knowledge. **Questions:** 1. a. How do you describe an acid and base? b. Give some examples of acids and bases that have encountered in your everyday life. c. list as many as sour and bitter foods as possible, which you have ever tested 2. Achol has prepared milk for her child , after some Few days the test of the milk change to sour. a. Is the test of milk containing an acid and base? b. What kind of acid or base is the sour milk Contain? c. What is the colour milk at that kind of test? 3. Name the acid that is found in the stomach. 4. a. without using indicator, how could you test Whether the food is an acid or base? b. why should you do this with any substance other than food? 5. Is sodium (kombo) an acid or base? Explain. 6. If a bee bit someone, why is it pain too much? How do you reduce that pain from bee bite?		
EXPLORE • Teacher provides pupils with common experiences. • Make posters explaining instruments, safety icons and appropriate laboratory behavior. • Teacher helps the pupils from Preparation of universal indicator from the plants materials. • Guiding the pupils from the exploration • Teacher asks pupils how to test acids and Bases using indicator.	15 mins	• They should be involved in investigating , collecting evidence, discussing their observation and keeping records • Pupils prepare universal indicator from the plants materials.

		• Pupils prepare some juices from the fruits. • The pupils carry out hands-on-activities that allow them t explore their concepts of topics. • pupils work in-group to carry out • Some experiments.
EXPLAIN • The teacher explains sources of the solutions. • The teacher use some form of literary products to help in assess what the learners have understood and offers natural opportunities for formative assessment i.e. a scientific report, a written explanation , a talk ,a presentation, an annotated diagram ,a cartoon, a podcast, a model, a drama etc. • The teacher tells the learner to work in a group in investigation. • Teacher guide pupils in carrying of experiments i.e. observe and test the behavior of substances. • Teacher question and probe pupils` understanding ,to ensure that the concepts are correctly formed in pupils` minds	5 minutes each day (10x4=40mins)	• Learners say, do write and Make. • Learners represent their developing understanding and discuss patterns and Relationships. • Pupils discuss the current views and work of scientists to deepen their own understandings
ELAORATE • The science Teacher question the learners for what application should be made from the knowledge gained from the explanations and demonstrations on acid and base. • The science teacher assesses the understanding of the earlier exploring and investigating stages of the learner. • Science Teacher direct and asks the pupils on how to identify acids and base substances. • Science Teacher encourages pupils to discuss in groups.The science teacher motivates the groups for their well work done.	5minutes each day (10x4=40 mins)	• Pupils practice skills and behaviors. • Pupils discuss and compare their ideas with others. • Pupils carrying out simple experiments. • They carried out an investigation and recorded their results.

		• Learners used their understanding to transfer skills and concepts to new and more complex situations. • Pupils do some research from textbooks, internets, peers teachers, etc.
EVALUATE • Science teacher will evaluate his/her pupils by a short written quiz to know whether the pupils have learned the concept. A. **Choose the correct answer from the alternatives** 1. Water is added to a quantity of soil and the mixture shaken and filtered. When red litmus solution is added to the filtrate, the filtrate turned blue. The result showed that the soil is a. Acidic b).Alkaline c) clayed d) neutral 2. Salt Lime juice is tested sour because it contains a. Acid b) alkali c) basic salt d).double salt 3. All the following may produce acids except a. Ash from cocoa husk b) Grapefruit c) .salt d) oil 4. Which of the following gases support burring? a. 02 b) C02 c) NH_3 d) C12 5. Which of the below is the P^H of pure drinking water? a. 1.5 b) 7 c) 12 d) 5 **B. Answer all the questions.** b. a. what is an acid and base? Give some examples of acid and base that you have encountered in your everyday life. b. List as many as sour and bitter foods as possible ,which you have ever tested c. Achol has prepared milk for her child, after some few days the test of the milk change to sour. a. Is the test of the milk containing an acid or base? b. What kind of acid or base is the sour milk contain? c. What is the colour milk at the kind of test? d. Name the acid that is found in the stomach. e. a. without using an indicator, how could you test whether the food is an acid or base? c. Why should you do this with any substance other	5 Minutes (10x4=40mins)	• Learners` demonstrate their new understandings and reflect on the learning journey, record their achievements and set next steps. • Pupils evaluate what they have known at the same time by solving the given questions.

than food? Is sodium (kombo) an acid or base? Explain. f. If a bee bit someone, why is it pain too much? How do you reduce that pain from the bee bite? g. Why the test of a red paper is bitter? h. How do you reduce the bitterness of the test of the red paper? Explain		

IIMS Resources:

**Teacher /student`s materials;** power point lecture notes, Chalkboard ,pointer, ruler, student`s attendance book, record book, ,knife, fruits ,water, flowers, standard litmus paper, tomatoes, lemons, oranges, wood-ash, soap , red onions, shampoo, soda, milk, cooking pot, filter paper ,beaker/glasses, pencil/pen ,notebook/sheet for practice, textbooks etc.

Assessment to be used in this lesson plan (formative and summative)

Pre-test questions: As seen at the engagement phase

Post-test (quiz) seen at evolution phase

Formative assessments: pupils will be given exercise. Seen at power point science teacher notes the description of the exercise for details.

Homework extension: pupils will be given small project to investigate. Seen at power point science teacher notes the description of the project for details.

Teacher: Andu Mikaya Bethuel **Sign**:…….

Lesson plan for control group

The objective of this lesson plan is to determine the efficiency of traditional instructional approach in pupils' deep understanding of acid ad base topic in science.

Daily lesson plan sample for control group exposed to lecture method. Traditional instructional method was used with IIMs.

Lesson1

Group: Control group

School Name: Gudele East One Primary school

Class: 8 **Number of students:** M = 11 F = 23 **Total =** 34

Teachers' Name: Andu Mikaya Bethuel **Subject:** science

Unit14: Properties of matter (Acid & base)

Subtopic: Acid & base

Lesson content; meaning of acid, properties of acids, examples of acids and uses of acids

Duration: 35 minutes

Objectives: By the end of this lesson students should be able to;

1. Explain the meaning of an acid
2. List the properties and examples of acids
3. List the uses of acids

Lesson Development

Time	Step	Teachers' activities	Students' activities
5	Review	• Reviewing of previous lesson • Corrections if there is any	• Listen and • following up teacher revision
20	Introduction	• Introduction of the daily lesson • Presentation • Giving notes • Showing diagrams, pictures from the textbooks	• Following up the teacher presentation • Taking notes • Listening to the teacher • Answering questions asked by the teacher
5	Summary	• Summarize the daily lesson about acid	• Listening to the summary
5	Evaluation	• Asking question coped on the chalkboard	• Students answer questions in their exercise books

Teachers' Name: Andu Mikaya Bethuel **Sign:**……