GROUNDNUT SHELL AS AN ALTERNATIVE SCULPTURE MATERIAL FOR MODELLING, CASTING AND CARVING: THE CASE OF SALAGA SENIOR HIGH SCHOOL, GHANA

By

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DECLARATION

I hereby declare that this submission is my own work and that, to the best of my knowledge and belief, it contains no material previously published or written by another person nor material which to a substantial extent has been accepted for the award of any other degree or diploma at Kwame Nkrumah University of Science and Technology, Kumasi or any other educational institution, except where due acknowledgement is made in the thesis.

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ABSTRACT

This study has explored groundnut shell which is normally burnt or dumped in the environment as an alternative sculpture material for modeling, casting and carving. The researcher adopted quantitative and qualitative research approaches with quasi experimental, action, descriptive and project based methods. Quota sampling technique was used to select 44 out of 145 students in the Department of Visual Arts, Salaga Senior High School. Interview and observation were used to collect data. The data was analyzed using tabulations, percentages, and descriptions. As a pioneering project, the study has made a significant contribution to knowledge. The results revealed that groundnut shell is a suitable material for sculpture. The following recommendations were made; Sculpture tutors and students at all levels of educational institutions as well as sculpture industries in Ghana should make use of groundnut shell which to a very large extent will reduce cost, deforestation, and environmental pollution. It will also improve groundnut cultivation in the country. Curriculum Research and Development Division of Ghana Education Service should include groundnut shell in the teaching syllabus as one of the major sculpture materials since it is inexpensive and also suitable material.

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CHAPTER ONE

INTRODUCTION

1.1 Overview

Chapter one as an introductory chapter, vividly describes what the researcher intended to do and how the results were achieved and analyzed. The chapter one encompasses the Background to the Study, Statement of the Problem, and Objectives of the study as well as Research Questions, Delimitation, Limitation, and Definition of Terms. Others are Importance of the Study, Abbreviations, and Organization of the Rest of the Text.

1.2 Background to the Study

According to archaeologists, groundnut cultivation began around 8000 years ago in the valleys of Paraguay. It is grown in hot climatic areas around the world. Summer time is the best season for its cultivation. One of the very healthy foods is groundnut. It contained vitamin B, vitamin E, dietary fiber, fiber, oils, magnesium, manganese as well as phosphorus. One can eat it raw apart from using it to make groundnut-based foods based including butter, cookies and candy bars (Nisha, 2015).

South Americans started groundnut cultivation around 7500 years ago. Groundnut plant reached Mexico in the first century where it spread to North America, China, and Africa (worldatlas, 2016).

China ranks first among the ten major groundnut producing countries in the world since 2006. China produces around 18.7 million metric tons of groundnuts each year. The Northern and Southern China is mainly for groundnut cultivation. Nigeria also ranks first among the major groundnut producing countries in Africa. Nigeria produces about 3.8 million metric tons in a year. Northern Nigeria has produced is significant amount of groundnut because its climate is very good for cultivation of groundnut (Nisha, 2015).

According to Nisha (2015), Ghana ranks tenth in the world and fourth in Africa among the top-ten-biggest groundnut producing Countries. Northern Ghana produces more groundnuts than the Southern part of the country because of the warm and temperate climate.

GRATIS Foundation has manufactured a groundnut oil extracting machine which helps to improve the cultivation of groundnuts on a large scale in the Northern Ghana. The machine could extract one gallon of oil in 30 minutes (Anon., 2004).

Groundnut is also known as peanut, earthnut, Chinese nut or goober. Groundnut shell is called groundnut hull or groundnut husk. In groundnut producing countries, groundnut shell is normally burnt or dumped in the environment to deteriorate naturally. It consists of fragmented shells with variable amount of whole or broken kernel (Heuzé et al., 2017).

The ten-top-biggest groundnut producing countries in the world can be seen in table 1.2 (Nisha, 2015; Carroll, 2016).

Table 1.2 The ten-top-biggest groundnut producing countries in the world

Country	Rank	Production (million metric tons)
China	1st	18.7
India	2nd	6.8
USA	3rd	4.1
Nigeria	4th	3.8
Burma	5th	2.0
Indonesia	6th	1.9
Argentina	7th	1.1
Chad	8th	0.8
Senegal	9th	0.6
Ghana	10th	0.4

According to AGICO (2012), groundnut shell is the main by-product of the groundnut processing factories and could be customized as a nutritional feed or used for many different purposes such as fuel, soap or furniture production.

According to Heuzé et al (2017), 2015 world's production of groundnuts in shells was about 40 million tons. **40%** came from China, 19% from countries in Asian, 18% from Africa and 11% the American countries. Presuming that the shell of groundnut comprises 20% of its weight, about 8 million tons of groundnut shells would be produced every year.

1.3 Statement of the Problem

Groundnut shell is a bulky waste in this country generated from activities of processing groundnut for food and other purposes. It is normally burnt, dumped or left in the environment to deteriorate naturally. These pose many health hazards to people and also carve a bad image for the future of the country. Utilization of groundnut shell to feed livestock helps alleviate environmental burdens in groundnut producing countries. This has awakened people's interest in using groundnut shell to produce fuels, feed, soap and many others (Heuzé et al., 2017).

The common materials used for teaching modelling, casting and carving in Salaga Senior High school include clay, cement, and wood respectively. Using these materials comes with so many demerits. For example, clay models must be fired to become permanent. Works of clay and cement are very heavy and fragile. Clay and wood works crack in the process of drying due to the harsh weather condition in the Northern Region. Wood works easily deteriorate due to weevil attack and besides, there are few trees in the Northern Ghana. According to the literature available, groundnut shell has been used for the production of fuels, ply woods, soap, electric power, craft work and others. However, it has never been used for modelling, casting, and carving in sculpture.

Consequently, there was the need for the investigator to critically examine how groundnut shell could be used for modelling, casting and carving of sculpture works, since it is inexpensive, light in weight, and can be acquired easily. Using groundnut shell as an alternative and environmentally friendly sculpture material for modeling, casting and carving at Salaga SHS to a very large extent will reduce cost, deforestation,

environmental pollution and also improve the cultivation of groundnut in the Northern Region of Ghana.

1.4 Objectives of the Study

Objectives of the study are to:

1. To experiment groundnut shell powder with selected binders which react positively.

2. To model, cast a board and carve sculpture works in bound groundnut shell with students in Salaga Senior High School.

1.5 Research Questions

1. What are the reactions of groundnut shell powder with the selected binders?
2. How will the bound groundnut shell powder be used to model, cast board and carve a sculpture with students in senior high school?

1.6 Delimitation

Geographically, the study was conducted at the Visual Arts Department, Salaga Senior High School in the Northern Region. The population includes all the Visual Arts Students in the Department. Contextually, the study was based on the utilization of groundnut shell for teaching modelling, casting and carving in sculpture.

1.7 Limitation

Groundnut shell has never been used by any artist to model, cast, or carve sculpture works in Ghana and other parts of the world. Though, few artists have used it for the production of art works through assemblage, construction, and painting. As a result, there was no enough literature for the study.

1.8 Definition of Terms

Groundnut– it is leguminous crop grown purposely for its edible seeds.

Shell– shell is the hard outer part that covers and protects a seed.

Modelling– a technique of adding clay or any pliable material bit by bit with tools such as spatulas, knives, scoopers etc. to achieve a desired form.

Casting– the process of reproducing sculpture a work by filling a mould with a molten or slurry material and after hardening, the mould is removed.

Carving– the art of using tools like chisels, gouges, adzes etc., to remove certain portions of wood, stone, ivory or any solid material to form sculpture.

1.9 Importance of the Study

- The study will introduce an additional material to the existing ones in sculpture which is equally suitable for modelling, casting, and carving.

- The thesis will serve as a reference material to other researchers, artists, art educators and students in Ghana.

- This study will inspire others to research into waste products for sculpture production.

- The outcome of this study will go a very long way to reduce environmental pollutions and deforestation in Ghana.

- The study will create jobs and reduce unemployment rate in the country because the artists will depend on other people in collecting groundnut shell and milling for large productions.

1.12 Abbreviations

- POP–Plaster of Paris

- WASSCE–West Africa Secondary School Certificate Examination

1.13 Organization of the Rest of the Text

The entire research work is made up of five chapters, ranging from chapter one to chapter five. Chapter one is an introduction which vividly describes what the researcher intended to do and how the results were achieved and analyzed. Chapter two is mainly review of related literature to the study. Chapter three comprises of methodology which include the processes and procedures. Chapter four entails presentation and discussion of results. Chapter five is the last chapter which consists of summary, conclusions and recommendations.

CHAPTER TWO

REVIEW OF RELATED LITERATURE

2.1 Overview

Groundnut shell has been used by few artists and practitioners in other fields for many things including art production. As a result, a scanty literature was available on utilization of groundnut shells for art production which did not include modelling, casting, and carving in sculpture. The chapter two principally reviews literature on groundnut shell, composition of groundnut shell, the strength of bound groundnut shell, uses of groundnut shell in Ghana and other parts of the world. It also reviews literature on binding materials and techniques involved in using groundnut shell for art production as well as modeling, casting, carving, conceptual framework and art appreciation.

2.2 Groundnut Shell

Groundnut is made up of an external shell which covers the seed. Groundnut shell is end product of processed groundnut. Groundnut shelling is often the second activity in groundnut processing for making oil, nibbles, and other groundnut-based foods which require seeds. Groundnut shell usually consists of split shells with flexible amounts of complete or broken seeds (Heuzé et al., 2017).

Groundnut shell could be used in making pellet fuels for house fireplaces and industrial biomass stoves. Some oil could be produced out of groundnut shells which is a perfect matter for soap production. After certain chemical treatments, groundnut shell could be used to produce sticks (fire wood), high quality boards for furniture and other wooden

tools. Gum which is used for high quality plywood productions can also be produced from groundnut shells (AGICO, 2012).

Due to their high fibre content, groundnut shells have a high potential as a low-quality fibre source, particularly as substitute to hay in hot and dry weathers (Palmer, 2010; Aregheore, 2001).

The main reason for cultivating groundnut is to produce oil and meal. Groundnut shell is normally burnt or dumped to deteriorate naturally. Environmental concerns have aroused people's interest in using groundnut shell for fuel, mulch, manures, transportation of chemicals, bedding for cattle and fowls, pet litter, soil conditioners, etc. (Heuzé et al., 2017).

2.3 Composition of Groundnut Shell

Peanut shells are made up of lignin, cellulose, proteins and carbohydrates. The percentage composition of the components is protein-8.2%, lignin -28.8%, cellulose - 37.0%, and carbohydrate -2.5% (Sanariya, 2016).

The chemical composition of groundnut shell is protein-8.2%, lignin-28.8%, cellulose-37.0%, and carbohydrate-2.5%. There are different types of groundnut but the compositions of their shells are almost the same (Sagarjawla, 2016).

The chemical composition of groundnut shell is protein-8.2%, lignin-28.8%, cellulose-37.0%, and carbohydrate-2.5% (Kingman, 1992-2016).

2.4 The Strength of Bond Groundnut Shell

Groundnut shell briquettes are strong and will not disintegrate with time or crumble while on transformation (Ajobo, 2014).

According to AGICO (2012), groundnut shell is used for the production of gum for high quality plywood and boards for furniture and other wooden tools.

2.5 Uses of Groundnut Shell in Ghana and Other Parts of the World

Groundnut shell is used for the production of soap, cosmetics, wallboard, plastics and linoleum, among other things. Scientist and educator, George Washington Carver commended the value of groundnuts as well the shells as early as the 20th century. During the 21st century, scientists at Clark Atlanta University studied ways to use groundnut shells to produce hydrogen for fuel (Roberts, 2017).

There are fuel briquettes making business in Gambia by Anthony Tabbal. He got the inspiration from his worry about the way trees are felled for firewood or charcoal which was causing deforestation. Groundnut industries in Gambia have disposed groundnut shell abundantly which he used to make fuel briquettes (Chaix, 2012).

Green Tech Company limited in Gambia started pressing high quality groundnut shell fuel briquettes around 2011. The company designed and promoted fuel efficient stoves that local welders can manufacture by using recycled metal. Using the efficient stove with fuel briquettes is more economical as compared to the conventional method of cooking with charcoal or firewood (Anon., 2018).

In groundnut producing countries, groundnut shells are a main manufacturing waste which causes pollution. Utilization of groundnut shell to feed livestock helps alleviate environmental burden (Heuzé et al., 2017).

One of the major food industrial waste products is groundnut shell which could be used in extracting environmentally harmful copper ions from waste water, according to investigators in Turkey (Publishers, 2007).

Senegalese produced a high-quality charcoal from waste peanut shells to replace a more traditional, wood-derived charcoal to Combat deforestation and conserve their tropical forests (Pagett, 2013).

The first discarded material which is highly effective for cleaning wastewater is groundnut shell which cleans about 95 percent of the copper ions. Wastewater from electroplating, pulp and paperboard industries contains copper that can affect marine and human life. Copper, can damage the human liver (Bhatta, 2008).

Many factories have started purchasing groundnut shells for power generation. When groundnut shells are burnt in the waste incineration plants, it generates superheated steam in boilers. The steam is in turn used to drive turbo generators to produce biomass electricity. Groundnut shells are in high demand in factories because biomass electricity is cheaper than hydroelectricity yet serves the same purpose (Adikin, 2017).

A group of scientists in Canada have managed to create a mixture sodium ion capacitor (NIC) from groundnut shells. The lines are blurred between conventional ion batteries and super-capacitors, thereby offering a much better way to store and deliver electrical power (Desai, 2014).

In Senegal, a village called Kalom had power supplied by a biomass power station, which uses peanut shells supplied by local small farmers (Anon., 2010, 2012).

Groundnut shell could be customized as a nutritional feed or used in making pellet fuels for house fireplaces and industrial biomass stoves. Gum which is used for high quality plywood productions can also be produced from groundnut shells (AGICO, 2012).

Groundnut shells have also been used successfully to produce light weight concrete and the blend of waste groundnut shells and high-density polyethylene as reductants in the microwave produces iron ore (Dankwah, 2017).

2.6 Binding Materials and Techniques Involved in Using Groundnut Shell for Art Production

Ajobo (2014) produced groundnut shell briquettes for fuel by using cassava starch as binding material. This was carried out in a briquette machine (using bottle jack with guage) which has a slider arm with dimension (410 x 330 x 25), angle bar (75 x 75 x 3658), rod of diameter (25 x 25 x 300), ram plate (360 x 100 x 4), frame (430 x 460 x 1000) and compression compartment (360 x 105 x 115) all in mm.

Figure 2.6.1 Briquette machine with bottle jack
Source: (Ajobo, 2014)

Beautiful decorative flowers can be made from groundnut shell by using glue to fix the shells to a stick one after another. The groundnut shells are fixed in a rotating manner to get the shape of flowers. Single seeded groundnut shells are used for making the leaves (Ideas, 2015).

Figure 2.6.2 Flower made from groundnut shell
Source: (Ideas, 2015)

Casino collects groundnut shells transform them to amazing things through a subtle painting and posing process. Casino shells groundnut without causing any damage to the shells, which he then uses as tiny canvases. Once the paint dries, he seals it with a clear acrylic coating. After drying of the acrylic, the final work is preserved in a glass dome (Steinhardt, 2015).

Figure 2.6.3 Boxer by Steve Casino
Source: (Steinhardt, 2015)

Steve Casino decided to paint a face on the peanut shell and after experimenting with

the self-portrait, Casino turned to one of his favorite bands for inspiration. In just five

months, Casino made about 30 creations from peanut shells (Dawn, 2013).

Figure 2.6.4 Celebrities by Steve Casino
Source: (Dawn, 2013)

Steve Casino in the US has created amazing tiny statues of his favourite celebrities by painting their likeness onto peanut shells. He has made almost 100 of the tiny four-inch statuettes (Kirkova, 2014).

Danielle Jones created birds by gluing and fixing groundnut shells with other suitable materials (Jones, 2017).

Figure 2.6.5 Birds by Danielle Jones
Source: (Jones, 2017)

2.7 Modelling, Casting, and Carving

Modelling

Modelling in sculpture is the process of adding plastic materials little by little to create a model by hand. Clay or wax can be used. Modelling tools are spatulas, scoopers or knives used in shaping the materials into desired forms. Modelling is one of the prehistoric methods of sculpture. The early sculptors from Egypt, the Middle East and other parts of the world have produced clay figurines through modelling. Modelled work, however, may be reproduced in metal or any suitable material by casting (Britannica, Modeling, 2017).

Pre historic metal sculptures that are found in Africa and other parts of the world were produced through the lost wax technique which has to do with a special method of modeling (Encyclopædia Britannica, 2017).

Casting

Lost-wax is a method of casting in which a hot metal is filled into a prepared mould from a wax model. The mould is made in such a way that the wax model is removed by means of fire leaving a hollow or space to be filled with hot metal substance from which a cast is made. Apart from Austria, the lux-wax method is common in all the continents. This method had been practiced from the 3rd millenary BC and since then, only few changes have been made (Britannica, Lost-wax process, 2017).

Casting is act of reproducing a sculpture piece by means of pouring a slurry material into a mould. A mould can be defined as a hollow cavity made from a sculpture model purposely for reproduction. POP, resin, metal and plastics are the common materials used casting (Group, 2017).

As far as casting is concerned, there must be a mould in which slurry material would be poured and after hardening it would be removed. Casting enables sculptors to reproduce works in more permanent materials. Today, this method is practiced more than as in the ancient times. Through casting, sculptor can easily make copies of a particular work.

Casting forms, a main activity in most machine building such as cast iron sleeves for diesel engines, cement, mining, minerals and earthmoving machinery, electrical and textile machinery and among others. A cast is an object produced by solidification of a

casting material in a mould. The mould is a cavity with every detail of the component to be produced (Adams, 2011).

Casting is a technique used in Architecture, Engineering, Bead making, Glass production, Sculpture, Ceramics and other fields of production. Lost-wax casting is also known as investment, precision or Cire-perdue casting. In this method of casting, a wax model is made and later melts to form a mould which is filled with hot metal substance to make a cast piece. It has been practiced among various cultures but the processes are always the same. Lost wax method in Africa was practiced in Nigeria, Ghana, and La Coted`Ivoire. Gold weights in Ghana are made through lost wax casting technique (Kissi, 2011).

Carving

Carving can be defined as a subtractive technique of sculpture production in which tools are used gradually to remove certain portions of a solid material and shaped in a desired form. Any material could be used for carving provided it has the properties that make it workable. Some of the materials for carving are wood, ivory, stone, bone and plaster of Paris (Agyen, 2013).

The various communities in Africa carve their objects according to their beliefs and customs. Hence, the Dogon, Baule, Senufo, Yoruba, Asante, Luba, Makonde and Kuba carvings differ in characteristic and stylistic features. In Ghana, carvings are produced for domestic, religious, social, economic, political and educational purposes. Some of these are Mortars, ladles and spoons, door panels, ancestral masks and figures, stools and thrones, drums and other musical instruments, weaving bobbins and other ritual and

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ceremonial objects. Some of the tools used for carving include carving knives, gouges, chisels, mallets, and adzes (Amoh, 2009).

Prehistoric people made implements and weapons through carving. The early Egyptians carved religious objects to protect the dead. Carvings among the Christian churches in the early era depicted the life of Christ for Christians who could not read. The people of South Pacific and Africa who could not also read produced carvings mainly for worship. Worldwide, people who live around sea or water bodies spend time carving models of ships. Adzes, knives, mallets, chisels and gouges are some of the tools that could be used for carving (Carstenson, 2018).

2.8 Conceptual Framework

Conceptual framework can be defined as a model adapted from an existing theory or constructed by researcher to suit a study (Adom, Hussein and Adu-Agyem, 2018). According to Adom et al (2018), Conceptual framework explains the relationship between the main variables or interconnected concepts and how to answer research problem. Conceptual framework is designed to propose answers to a research problem and encourage the development of a theory that would be useful to researchers in the field.

Conceptual framework is the researcher understanding of how the variables in a study connect with each other. It maps how the researcher pursued an investigation and identifies the required variables in the research (Regoniel, Patrick A., 2015).

Conceptual Framework
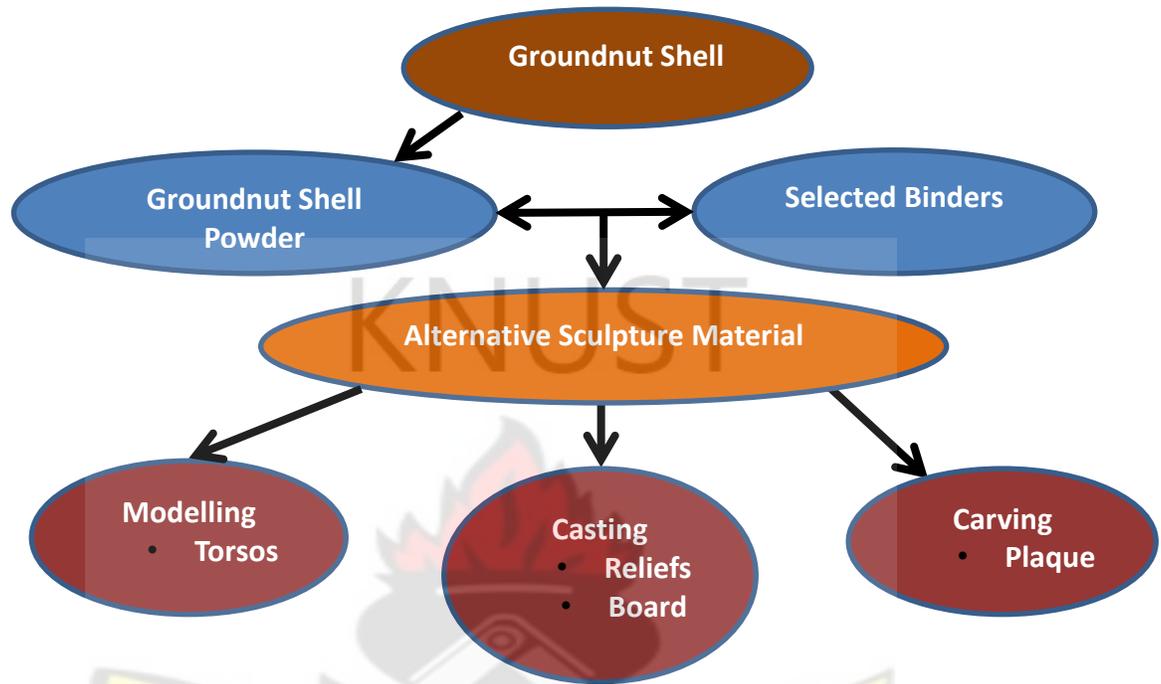
Figure 2.8 Conceptual Framework for the study

Source: Investigator's construct

2.9 Appreciation

Appreciation is the way we talk knowledgeably about everything in a work of art, to know and understand it better. Appreciation of an artwork helps one to study and understand the type of work it is, what it entails, how it was done, its meaning and uses. In art appreciation, one needs knowledge in the visual elements such and principles of art to appreciate a work effectively.

According to Yundle (2018), appreciation in art refers to the cognition of general or everlasting characteristics that classify great works of art. It refers to analyzing the form of an artwork to general audiences to enhance their enjoyment of such work. Appreciation of art can be non-objective depending on individual choice to aesthetics, form, the visual elements and principle of art, social and cultural credence.

The cognition and understanding of the general and everlasting qualities that characterize all great art is known as appreciation. An artist can develop, evaluate and enhance his or her work by appreciating art works of different periods, movements, styles and methods (Anon., 2018).

Art appreciation involves description, analysis and interpretation. Description (physical qualities and formal way of construction), Analysis (close study of the physical qualities in subjective manner), and Interpretation (meaning of work in relation to historical, religious, environmental, content, aesthetics and cultural value of the work) (Yundle, 2018). Analysis in this thesis entails a scholarly evaluation of the viability of groundnut shell powder for sculpture (validity, durability, suitability etc.).

CHAPTER THREE

METHODOLOGY

3.1 Overview

This chapter principally deals with the research methodology and general procedure for the study. The systematic theoretical analysis of procedures applied to a field of study is known as research methodology (Kothari, 2004). what constitute research methodology include research designs, target population, sample size and sampling technique, data collection instruments, validation of instruments as well as data analysis procedure.

A research method is a systematic plan in which research is conducted. Quantitative method is a research that aims classifying features, counts them, and creates statistical models to test hypotheses and explains observations. A qualitative method on the other hand, aims to complete detailed description of observations of events and circumstances (Moffitt, 2003-2018).

3.2 Research design

According to Kothari (2004), a plan, a roadmap or blueprint strategy that would help to obtain answers to research questions is research design. Research design is an action plan in which a research is built. It dictates how a research should be conducted and provides the road map for selecting the sample, data collection instruments and analysis procedure.

According to Williams (2007), research approaches, paradigms or frameworks are either quantitative or qualitative or mixed approach. Choosing the design of a research depends on the kind of data needed to react to the research questions.

The researcher adopted quantitative and qualitative research approaches which provided numerical and text data for the study respectively. Quasi-experimental method was employed under the quantitative research while action, descriptive and project-based methods were chosen for qualitative research.

3.2.1 Quantitative Research

There is objectivity in data collection to create meaning through quantitative research. In quantitative research, investigators seek explanations and predictions that can be generalized to different people in other places. This approach is to set up, confirm, or validate relationships to develop generalizations and contribute to theory. The results from quantitative research are predictive, explanatory, and confirming (Williams, 2007).

3.2.2 Qualitative Research

Qualitative research formulates and builds new theories. Qualitative research is purposely used to describe, explain, and interpret data. Qualitative research is model that occurs in a natural setting and also enables the researcher to develop a level of detail from being extremely involved in the real experiences (Williams, 2007).

Qualitative method can also allow the investigator to discover and better appreciate the complexity of groundnut shell in a nonobjective manner. Qualitative research deals with

questions such as how? Why? What? Etc. through qualitative data, concepts and theories can be developed. This method will have enabled the researcher give detailed account of data collected through semi structured interview and participant observation, by analyzing and describing the data in a form of words.

3.2.3 Quasi-Experimental research

According to Shuttleworth (2008), the process in which groups are selected and a variable is tested, without any random pre-selection processes are called quasi experimental research. The process is like any other experiment, with a variable being compared with different groups. Since there is no pre-selection and randomization it reduces the cost of time or resources for experimentation. Quasi-experiment is a very powerful tool, especially where 'true' experiments cannot be conducted.

Quasi experimental method under the quantitative research was used to experiment groundnut shell powder with selected binding materials before using it for direct modelling, casting of board and carving of sculpture works. It helped the researcher to identify suitable binders for the material in the case of modelling, casting and carving. For instance, white glue is the best binder for modelling or carving, and styrofoam or synthetic resin for casting.

3.2.4 Action Research

Action research is an evaluative, investigative, and analytical method of research designed to analyze organizational, academic, or instructional problems and develop practical solutions to tackle them quickly and efficiently (Anon., 2014).

Typically, action research is undertaken in a school setting. It is a deep process that allows for investigation and discussion. Action Research is often a joint activity for probing solutions to everyday, real troubles in schools. It helps to improve instruction and increase student performance (Ferrance, 2000).

Through action research which is qualitative, the researcher used bond groundnut shell as an alternative and environmentally friendly material to teach students of Salaga SHS how to model, cast and carve sculpture works.

3.2.5 Descriptive research

Descriptive research describes records, analyzes, and interprets the current nature and composition of phenomena. It focuses on current conditions for instance, how a person, group, or thing behaves or functions (Joy, 2014). Descriptive research which falls under qualitative helped the researcher to describe in detail, the processes and results of the experiment on groundnut shell through observation.

3.2.6 Project-based research

Project-based research is a genuine instructional strategy in which students to plan, implement, and evaluate projects. Students gain fun and motivation through active engagement in projects, first-hand learning experiences, and learning by doing. Project-based instructional model is rooted in constructivist approach evolved from the work of psychologists and educators such as Lev Vygotsky, Jerome Bruner, Jean Piaget and John Dewey. Constructivism views learning as the outcome of constructing original skill or ideas based on past experience. Project-based instruction provides wider range of learning opportunities for individual with different learning styles. The learner is provided with potential tools for making discoveries through explorations (Makafui, 2015).

Project based research enabled the researcher to provide the requisite tools for respondents to explore with groundnut shell bond with various binding materials, plan and execute sculpture works based on their experience in modeling, casting and carving. It offered students the opportunity and motivation to learn by doing which enhanced the learning.

3.3 Study and Target Population

Study population is a section of the target population of which investigators apply their conclusions. Target population is the whole group of persons or objects to which investigators are paying attention in generalizing their conclusions. Researchers draw their samples from the study populations (Anon., 2009).

The target population is 145 which include students of form one, two and three in Department of Visual Arts, Salaga SHS.

Table 3.4.1 Study and Target Population

Class	Target Population
SHS One V/A	65
SHS Two V/A	34
SHS Three V/A	46
Total	145

3.4 Sample and Sampling Technique

According to Cherry (2017), the subset of a population used to represent the entire population is called sample whiles sampling technique is the method used in selecting sample for a study.

Quota sampling is a process in which an investigator intentionally selects a specific proportion of subgroups in a population as sample by ensuring that it is comprise of certain percentage of these subgroups. Quota sampling is a type of sampling that does not give every individual in a population an equal chance of being chosen as participant (Cherry, 2017).

Quota sampling technique was used to select the sample of 44 students from the target population of 145 students in the Department of Visual Arts, Salaga SHS. The sample was selected based on a report from the Ministry of Education that an average class size in second cycle institutions in Ghana should not be more than 45 (Anon., 2009). Hence, the researcher selected 30% of 65, 34 and 46 which are the total number of students in SHS one (1), two (2) and three (3) respectively to get the sample of 44 students for the study.

Table 3.4.2 Sample and Sampling Technique

Class	Accessible population	Sample size (Quota sampling 30%)
SHS One V/A	65	20
SHS Two V/A	34	10
SHS Three V/A	46	14
Total	145	44

3.5 Primary and Secondary Data

The researcher collected primary data through observation, description and interview with the respondents. Secondary data were collected from books, theses, articles, peer reviewed, journals and other written documents in the library and on the internet, that were related to the study.

3.6 Data Collection Instruments

Data collection instrument is a means through which data is collected depending on the methods used. As long as quasi-experiment, action, descriptive and project based research methods are concerned, the data were collected through semi-structured interview and classroom observation.

Participant observation is normally used to collect qualitative data. It is a strategy that helps researchers to systematically observe the routine activities of respondents while joining them. Through fieldwork classroom observation is exploratory and descriptive with very few tough and fast guidelines. It may demand that an investigator stay to in the field for several weeks or months. An observant investigator can increase important insight into respondents' behaviour. Observation can be open or covert (Moffitt, 2003-2018).

In semi-structured interview, an investigator personally asks participants a series of questions and offers them freedom to react the way they like (Moffitt, 2003-2018). Semi-structured interview is a guided conversation between the researcher and participant in which the researcher focuses on gathering all the information needed to answer research question. It is structured in a way that allows the researcher to probe participants and get more details about their thoughts, feelings, and opinions (Olivia, 2017).

Interview is data collection instrument that can help the researcher to get firsthand information personally from the respondents. An interview is purposely meant to disclose present knowledge in the form of responses which become available to interpretation. Participant observation is also a data collection instrument in which the

researcher directly interacts with students in the classroom to collect data by observing the classroom communications and activities as they really happen (Zohrabi 2013).

Participant observation helped the researcher to collect quantitative data through quasi experiments conducted by the researcher with the students on groundnut shell powder with selected binders. The researcher also used it to collect qualitative data by observing, interacting and describing the events that occurred during modelling, casting, and carving of sculpture works in bond groundnut shell powder.

After guiding the student of Salaga SHS to produce sculpture works in bound groundnut shell, the researcher used the semi-structured interview to collect qualitative data by interviewing them about groundnut shell as an alternative sculptural material for modelling, casting and carving.

3.7 Validation of Instruments

According to Zohrabi (2013) interviews and classroom observations can complement each other to increase data's validity or dependability. Researcher prepared an interview guide and showed it to colleagues to ensure that, it was accurate before given to the supervisor for further corrections study and approval.

3.8 Administrations of the Instruments

The works produced in groundnut shell together with some of the works in conventional materials were assembled before the respondents and administration of the interview. Through face to face interaction and interview with the respondents the researcher was

able to locate a place in Salaga where the shelling of groundnut was done with a machine.

The researcher did observation and described all the events from acquisition of groundnut shell, treatment, and how it was used for modelling, casting, and carving of sculpture works. The researcher made arrangement and visited the site with some of the students to observe and take photographs. The researcher's personal observation confirmed that, groundnut shell is available in abundance and the way it has been disposed can cause problems in the environment. Besides, the researcher assigned some students to bring groundnut shells that the shelling is done manually. The researcher was allowed to collect the groundnut shell as much as the quantity needed free.

3.9 Data collection Procedure

Throughout the study, the researcher described and documented all interactions, observations and interviews with the students. These range from the acquisition of groundnut shell, treatment, quasi experimenting on the material with selected binding materials through casting, production of sculpture works in bond groundnut shell powder through modeling, casting, and carving.

3.10 Data Analysis Plan

The data were assembled, analyzed, and interpreted using tabulations, descriptions as well as percentages to derive the findings, conclusions, and recommendations.

3.11 Reasons for Selecting Groundnut Shell for the Project

US-based toy inventor Steve Casino and others artists have used groundnut shell with glue as a binding material to create flowers, birds, and amazing tiny statues. They did not use groundnut shell that was completely damaged for their art production which the researcher intends to accomplish in this study.

Ajobo (2014) also produced groundnut shell briquettes by using cassava starch as binding material. Using Groundnut shell as sculpture material can reduce environment problems, deforestation and also improve the cultivation of groundnut in Ghana on a large scale. For that reason, the researcher milled groundnut shell into powder and bond it with Styrofoam, white glue, contact adhesive glue type-99, cassava starch and synthetic resin to produce sculpture works. Groundnut shell is a non-toxic waste material, very common and inexpensive because it is normally burnt or dumped in the environment to deteriorate.

3.12 Tools, Equipment, and Materials for the Project

Tools

Hammer, nails and saw wood for creating a frame which was used to cast groundnut shell board for carving. Gouges, chisels and mallet are used for carving and breaking of moulds from a cast. Knife and Spatulas for direct modelling with bond groundnut shell. (See figure 3.12.1)

Modelling tools   **Saw**   **Hammer**

Tape measure   **Cutter**   **Chisel**

Mallet   **Plirs**   **Sand papers**

Brushes   **Carving tools**   **Electric grinder**

Figure 3.12.1 Tools
Source: (by the investigator)

Equipment

These include a Sieve, plastic containers and silver containers, plastic sheets or sacks, and work benches. (See Figure 3.12.2)

Plastic containers   **Silver containers**

Coal pot   **Plastic sack**

Plastic sheet   **Sieve**

Figure 3.12.2 Equipment

Source: (by the investigator)

Materials

Materials used for the study are metal rods, groundnut shell, white glue, cassava starch, resin, wood, clay, and plaster of Paris etc. (See figure 3.12.3)

Metal rods	Wood	Nails	Clay
Plaster of Paris	Cassava starch	White glue	Styrofoam with petrol
99 glue	Resin	Oil with soap	Acrylic paints
	Varnish	Groundnut shell	

Figure 3.12.3 Materials
Source: (by the investigator)

3.13 Processes and Procedures

3.13.1 Acquisition of Groundnut Shell

Groundnut shell was obtained from groundnut farmers, households and many other places in Salaga in the Northern part of Ghana. The researcher also sourced groundnut shell for the project from the site of groundnut shelling machine in Salaga. At the shelling machine, the researcher collected as much as he needed for the project without paying anything because the people seem to have difficulty disposing it.

The groundnut shell went through the following treatment before it was sent for laboratory test to be conducted or used for modelling, casting and carving. Groundnut shells that came from the shelling machine were broken whiles the one that was brought by students from individual farmers' households were whole shells. (See figure 3.13.1.1 – figure 3.13.1.4)

Figure 3.13.1.1 groundnut shelling machine at Salaga
Source: (by the investigator)

Figure 3.13.1.2 Groundnut shells from the machine
Source: (by the investigator)

Figure 3.13.1.3 Manual shelling of groundnut
Source: (by the investigator)

Figure 3.13.1.4 Groundnut shells from manual shelling
Source: (by the investigator)

3.13.2 Treatment of Groundnut Shell

Cleaning

Since the researcher and the respondents removed impurities such as leaves, sticks, and stones from the groundnut shells that were collected. It was then washed with clean water and then dried. (See figure 3.13.2.1- figure 3.13.2.2)

Figure 3.13.2.1 Washing of groundnut shells
Source: (by the investigator)

Figure 3.13.2.2 Drying of the shells after washing
Source: (by the investigator)

Milling

After drying it under the sun, both whole and damaged groundnut shells were mixed together and milled into a powder form using an electronic milling machine. Some of the powder was sieved to get fine aggregate. The powders (fine and course aggregates) were kept in sacks and ready for use. (See figure 3.13.2.1 – figure3.13.2.5)
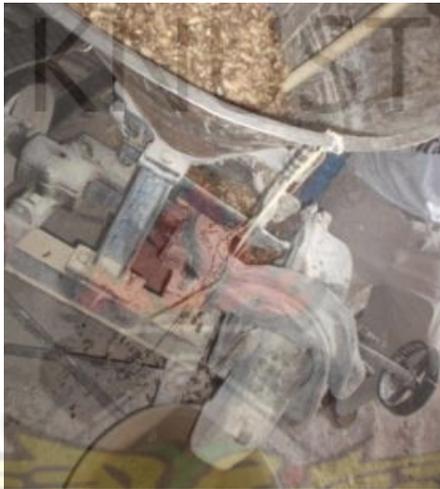
Figure 3.13.2.3 Milling of the groundnut shells
Source: (by the investigator)

Figure 3.13.2.4 Sieving of the milled shells
Source: (by the investigator)

Figure 3.13.2.5 Finer and course powdered shell in sacks ready for use
Source: (by the investigator)

Laboratory test for the chemical composition of groundnut shell

The researcher sent a sample of the groundnut shell powder to the Material Science Laboratory, KNUST, to test for its chemical composition. The researcher was later referred to the chemistry and central laboratory where the test was done (see results at the appendix). This helped the researcher to know whether groundnut shell contains some toxic chemicals or not and take good safety precautions while using it.

The test revealed that groundnut shell is composed of 90% Calcium Carbonate and 10% heavy metals and some minerals. (See table 3.13)

Table 3.13 Chemical Composition of Groundnut Shell

SN	Parameter		Value
1	Calcium Carbonate		90%
2	Heavy Metals	Cadmium	0.0567mg/l
3		Iron	0.0489mg/l
4		Lead	BDL
5		Copper	BDL
6		Arsenic	0.0217mg/l
7	Mineral Element	Sodium	5300mg/l
8		Potassium	1200mg/l
	BDL-Beyond detection limit		

3.15 Objective one: To experiment groundnut shell powder with selected binders which react positively

Obtaining moulds for the experiments

Idea development

The researcher guided students to make sketches of what they intended to produce with the groundnut shell. The sketches depict an arm holding a spear in the process of throwing. (See figure 3.15.1)
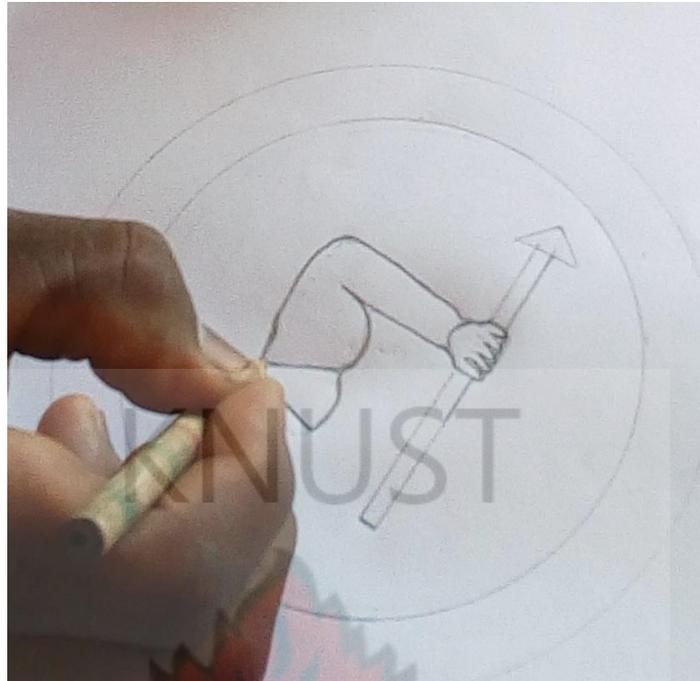
Figure 3.15.1 sketch of an arm holding spear
Source: (by the investigator)

Modelling and mould making

The researcher guided the students to model five soft clay relief models depicting an arm holding spear which is Ndewura Jakpa symbol (Gonja traditional Symbol) from which plaster moulds were made for the experiments. Plaster of Paris was mixed and poured onto the clay models to form the moulds. After setting of the plaster, the clay was removed leaving the moulds for the experiments. (See figure 3.15.1 – figure 3.15.5)

Figure 3.15.1 Students using their sketches to model reliefs in clay
Source: (by the investigator)
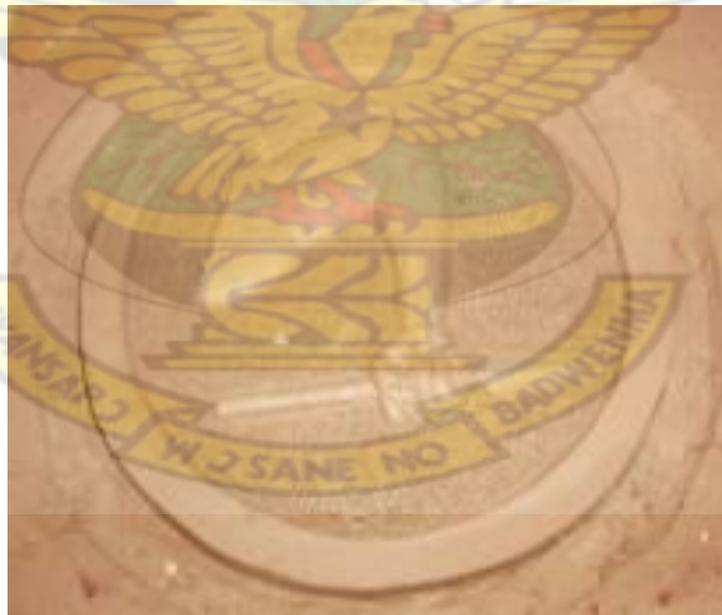
Figure 3.15.2 Soft clay relief model
Source: (by the investigator)

Figure 3.15.3 Pouring POP onto the model to form mould
Source: (by the investigator)
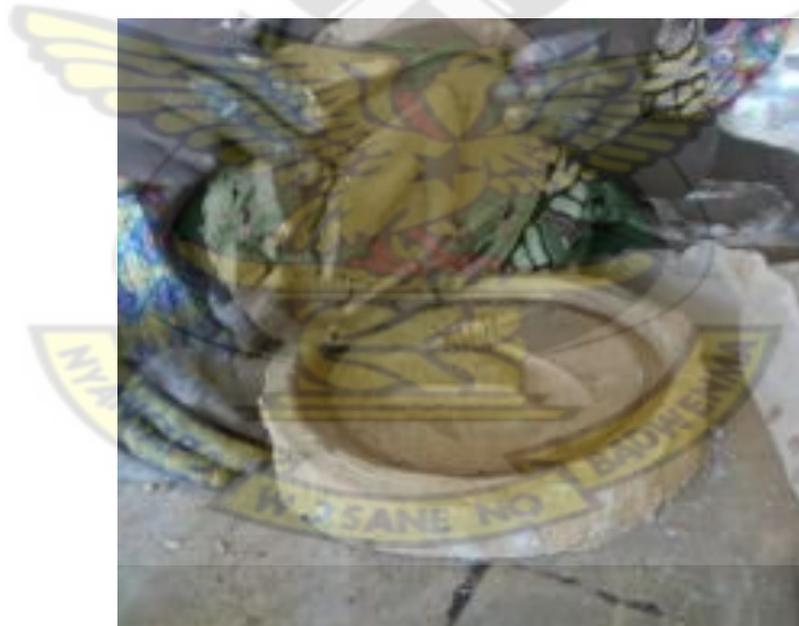
Figure 3.15.4 Removal of the model from the mould
Source: (by the investigator)

Figure 3.15.5 POP mould ready for casting
Source: (by the investigator)

Experimenting groundnut shell powder with the selected binders through casting

In a desired quantity, the researcher and the students mixed the groundnut shell power with selected binding materials which include white glue, contact adhesive glue type-99 styrofoam, cassava starch and synthetic resin. It was mixed with each binding material in an even consistency and poured into each mould one after the other. After setting and hardening of the casting material (bond groundnut shell powder), the moulds were removed leaving the cast pieces.

Experiment 1: Casting in groundnut shell powder bond with cassava starch

Preparation of starch

According to some of the students, when processing cassava for banko or gari, some of the starch is removed and thrown as waste. As far as this study was concerned, the researcher prepared the cassava starch with students.

The cassava was pealed with knife and then milled with an electronic milling machine. Some water was added to the milled cassava and with the aid of a sack, silver basin and pot the starch was squeezed out. After cooking, it was ready for use. (See figure 3.15.1 – figure 3.15.4)

Figure 3.15.6 Pealing of cassava
Source: (by the investigator)

Figure 3.15.7 Milling of cassava after pealing
Source: (by the investigator)

Figure 3.15.8 Squeezing milled cassava to remove starch
Source: (by the investigator)

Figure 3.15.9 Cooking of cassava starch
Source: (by the investigator)

Casting

The cassava starch was mixed with groundnut shell powder in a plastic bowl, stirred to

an even consistency and filled into the mould with hands. After setting, the mould was

removed using a chisel and mallet. (See figure 3.15.10 – figure 3.15.13)

Figure 3.15.10 Mixing cassava starch with groundnut shell powder
Source: (by the investigator)

Figure 3.15.11 Filling mould with the mixture
Source: (by the investigator)

Figure 3.15.12 Allowing the work to set and cure before removing the mould
Source: (by the investigator)
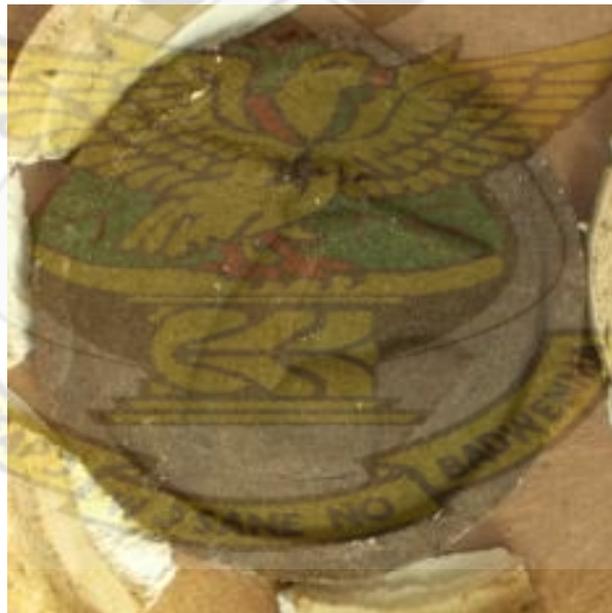
Figure 3.15.13 Cast piece after removing the mould
Source: (by the investigator)

Experiment Two: Casting in groundnut shell powder bond with styrofoam with petrol

The styrofoam was dissolved in the petrol before mixing it with the groundnut shell and filled into the mould with the hands. After setting, the mould was removed without causing any damage to it. (See figure 3.15.14 – figure 3.15.17)
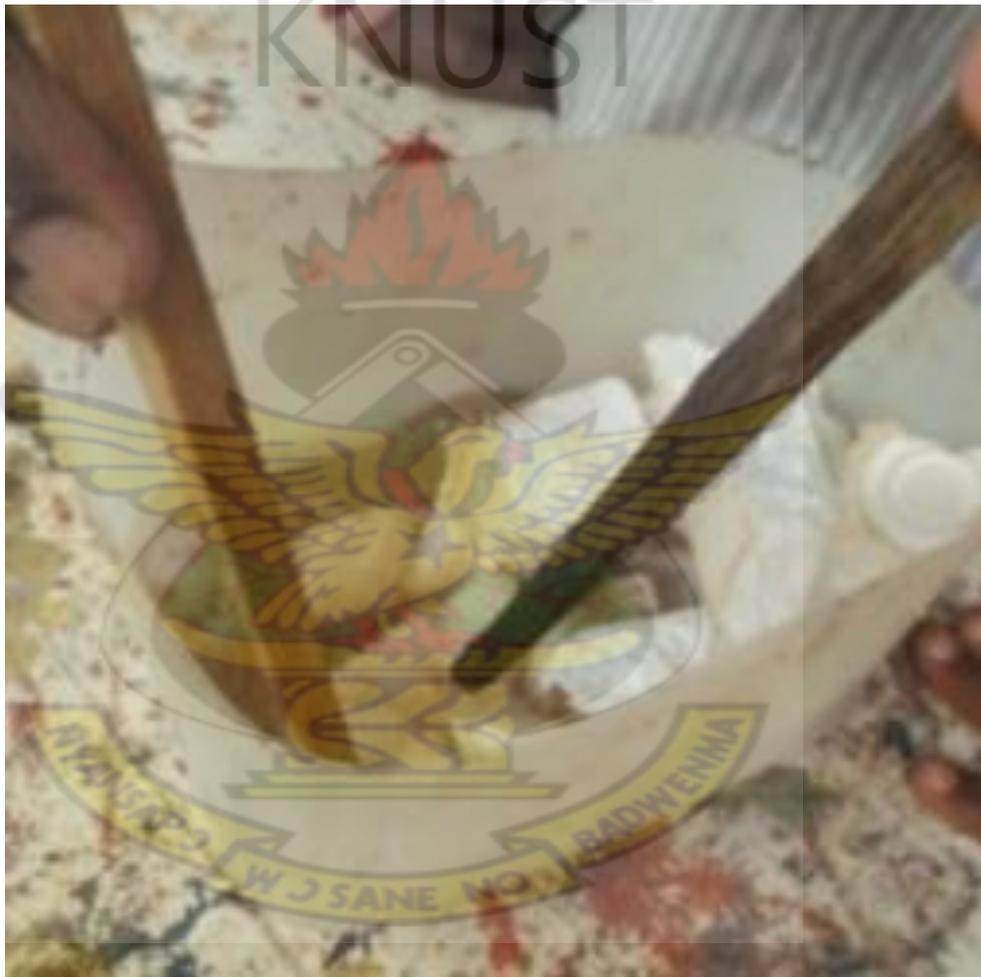
Figure 3.15.14 Mixing styrofoam with petrol before groundnut shell powder
Source: (by the investigator)

Figure 3.15.15 Mixing the binder with groundnut shell powder
Source: (by the investigator)

Figure 3.15.16 Filling of mould with the mixture
Source: (by the investigator)

Figure 3.15.17 Cast piece and its mould
Source: (by the investigator)

Experiment Three: Casting in groundnut shell powder bond with white glue

The white glue was diluted with some water and mixed with groundnut shell powder in a plastic bowl. The mixture was use to fill the mould and allowed to set which took several days. After setting, the mould was removed with a chisel and mallet. There were few casualties on the surface, which required mending, but the cast work was very strong. (See figure 3.15.18 - figure 3.15.21)

Figure 3.15.21 Mixing white glue with groundnut shell powder
Source: (by the investigator)

Figure 3.15.22 Filling the mould with the mixture
Source: (by the investigator)

Figure 3.15.23 Allowing work to set and cure before removing mould
Source: (by the investigator)

Figure 3.15.24 Cast piece after removing the mould
Source: (by the investigator)

Experiment Four: Casting in groundnut shell powder bond with contact adhesive type-99

The glue was diluted with some petrol and mixed with groundnut shell powder in a plastic bowl. After filling the mould, it did not take longer time to set and the mould was removed with a chisel and mallet. The cast was not smooth as expected. It was also lighter in weight and not very strong. (See figure 3.15.25 – figure 3.15.28)
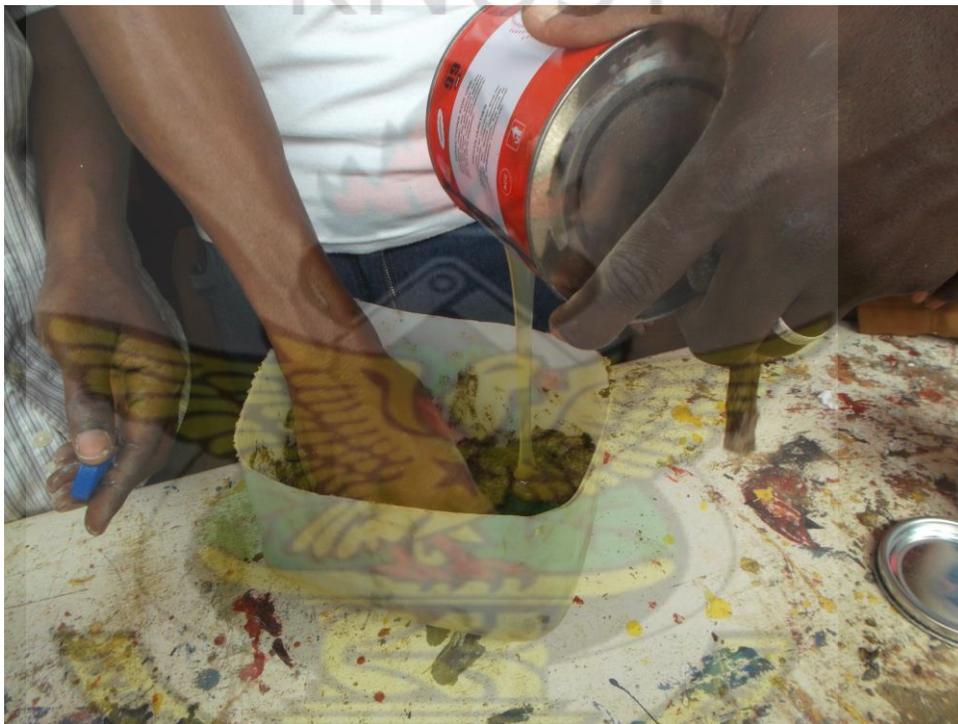
Figure 3.15.25 Mixing contact adhesive (99 glue) with groundnut shell powder
Source: (by the investigator)

Figure 3.15.26 Filling mould with the mixture
Source: (by the investigator)

Figure 3.15.27 Allowing work to set and cure before removing mould
Source: (by the investigator)

Figure 3.15.28 Cast piece after removing the mould
Source: (by the investigator)

Experiment Five: Casting in groundnut shell powder bond with synthetic resin

The resin was mixed with an accelerator in a plastic bowl before adding the groundnut shell powder. After stirring, a hardener was added to the mixture and poured into the mould. It sets within some minutes. The cast is heavier and stronger than the other cast pieces. (See figure 3.15.29 – figure 3.15.33)

Figure 3.15.29 Mixing resin with accelerator before groundnut shell powder
Source: (by the investigator)
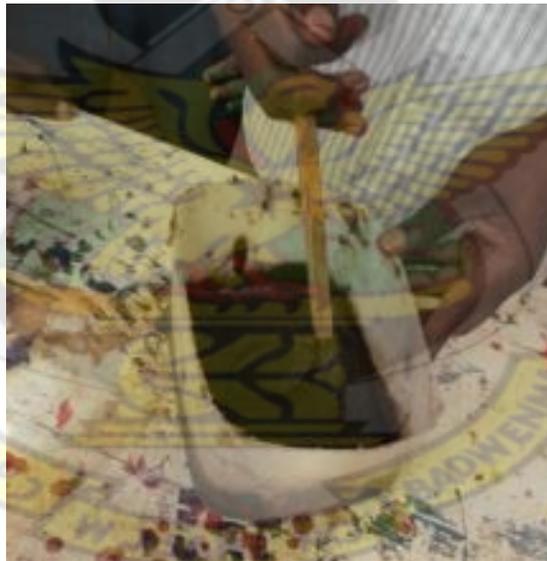
Figure 3.15.30 Mixing the resin with groundnut shell powder
Source: (by the investigator)

Figure 3.15.31 Pouring the mixture into mould after adding hardener
Source: (by the investigator)

Figure 3.15.332 Chipping off mould after setting and curing of material
Source: (by the investigator)

Figure 3.15.33 Cast piece after removing the mould
Source: (by the investigator)

3.16 Objective two: **To model, cast a board and carve sculpture works in bond groundnut shell with students in Salaga Senior High School.**

Modelling in Groundnut Shell Powder Bond with White Glue

Idea Development

The researcher guided students to make sketches of what they intended to model with the bond groundnut shell powder. The sketches depicted a nude female torso wearing beads (fgure 3.16 Sketch of a torso)

Figure 3.16 Sketch of a torso
Source: (by the investigator)

Modelling

The researcher guided the students to form armatures using binding wires and pliers that they used to model three unknown female torsos. The groundnut shell powder was mixed with white glue in a workable state for direct modelling. It was not plastic like clay but the researcher was able to guide the respondents to build it up onto the armatures and manipulate them to the desire forms. Spatulas, knives, and other modelling tools were used. After blocking, the models were allowed to set before modelling of details.

Figure 3.16.1 An armature and bond groundnut shell powder
Source: (by the investigator)

Figure 3.16.2 Adding the material bit by bit onto the armature
Source: (by the investigator)

Figure 3.16.3 Guiding a student to block a model
Source: (by the investigator)

Figure 3.16.4 Models allowed to set before continuation
Source: (by the investigator)

Figure 3.16.5 Torsos modelled directly in bond groundnut shell powder
Source: (by the investigator)

Casting of Board in Groundnut Shell Powder Bond with White Glue for Carving

The researcher used wood, saw, hammer, and nails to form a mould (wooden frame) and cast groundnut shell board for the carving. The frame was put on a surface with plastic sheet over it before filling it with groundnut shell powder bond with white glue. It was compressed with a wooden board and blocks to increase the setting speed and makes cast board compact. After setting, the mould was removed. The cast board was very strong and ready for carving. (See figure 3.16.6- figure 3.16.9)

Figure 3.16.6 Wooden mould for casting the board
Source: (by the investigator)

Figure 3.16.7 Mixing groundnut shell powder with white glue
Source: (by the investigator)

Figure 3.16.8 Filling mould with the mixture
Source: (by the investigator)

Figure 3.16.9 Cast board in bond groundnut shell powder
Source: (by the investigator)

Carving of the Cast Board in bond Groundnut Shell Powder

Idea development

The researcher guided students to make sketches of what they intended to carve with the bond groundnut shell powder board. The sketches depicted a plaque with the inscription "GROUNDNUT SHELL FOR MODELLING, CASTING AND CARVING". (figure 3.14.3)

Figure 3.14.3 sketching of plaque
Source: (by the investigator)

Carving

The cast board in bond groundnut shell powder was used for the carving. The researcher guided the respondents to use small gouges and other carving tools to carve the work.

The researcher intended to carve a plaque with the inscription "GROUNDNUT SHELL FOR MODELLING, CASTING AND CARVING". After sanding the board, the design of the plaque on paper was transferred onto it with the aid of white glue. A cutter was used to cut the outlines of the letters before scooping the unwanted parts with chisels and gouges. (See figure 3.16.10 - figure 3.16.14)

Figure 3.16.10 Sanding of the board before carving
Source: (by the investigator)

Figure 3.16.11 Sketch of the plaque transferred onto the board
Source: (by the investigator)
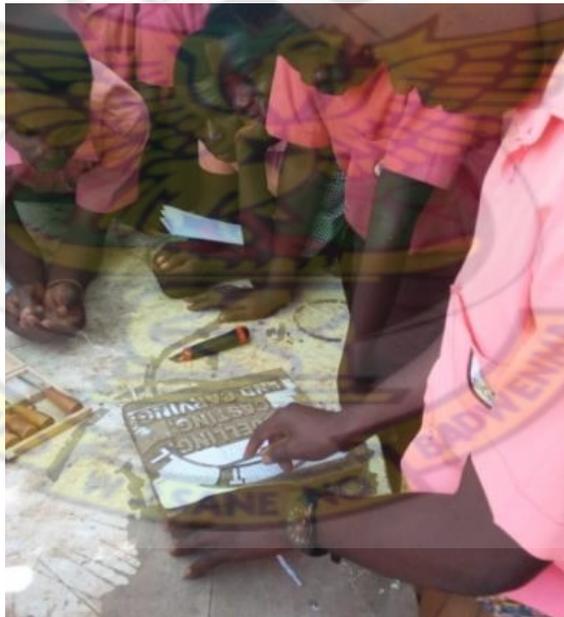
Figure 3.16.12 Carving of the letters and designs of the plaque
Source: (by the investigator)

Figure 3.16.13 Carved plaque in groundnut shell powder board
Source: (by the investigator)

Finishing and Finishes of the Works

Works that were produced with binding material such as styrofoam and resin were very strong. The researcher has to use a grinding machine to grind the edges. Finer or sieved groundnut shell powder with binders was used to mend works that were having casualties. Sand papers of different grades were used to smooth the works except the one which the groundnut shell powder was bond with contact adhesive glue type-99. The surface of that work was not strong as compared to the other binder and sanding it could remove some details. Finishes such as lacquer and acrylic paints were applied onto the works. With some of the works, paints were used to colour certain parts before applying varnish. (See figure 3.16.14 - figure 3.16.15)

Figure 3.16.14 Finishing work with an electric grinding machine
Source: (by the investigator)

Figure 3.16.15 Applying of finishes on the works
Source: (by the investigator)

CHAPTER FOUR

PRESENTATION AND DISCUSSION OF FINDINGS

4.1 Overview

Chapter four presents findings and discussion of results on groundnut shell as an alternative material for teaching modelling, casting, and carving. These include the results of experimenting groundnuts shell powder with some binding materials through casting, direct modeling and carving sculpture in groundnut shell powder. The experiments conducted confirm the suitability of groundnut shell powder for teaching modeling, casting, and carving. The data on this chapter and the entire project was gathered through interview and observation.

4.2 Major findings on groundnut shell

1. This study revealed that groundnut shell powder could be used as an alternative material for modeling, casting and carving of sculpture works.

2. Binding materials for groundnut shell include cassava starch, styrofoam, white glue, contact adhesive type-99 and synthetic resin. The plasticity in bond groundnut shell powder makes it possible for direct modelling and even casting of a board for carving. 3. In case of carving, groundnut shell powder could be bond white glue. Groundnut shell powder models are strong and can stand the test of time.

4.3 Findings for research question one: What are the reactions of groundnut shell powder with the selected binders?

Groundnut shell powder reacted positively with cassava starch, styrofoam, white glue, contact adhesive glue type 99 and synthetic resin. The researcher and students were able to use these materials to bind groundnut shell powder for sculpture production.

Sculptor can choose any of the binding agents depending on the purpose or technique that will be employed. For instance, white glue could be used if the sculptor intends to carve an indoor sculpture. Works produced in groundnut shell powder bond with resin or styrofoam can withstand insect or weevil attack, rain and other environmental elements.

Observation of experiment one: The reactions of groundnut shell powder bond with cassava starch

It was observed that the material was not toxic as fowls were eating the work while setting and the researcher has to either stay around or keep the work inside the studio. As a result, it took several days for it to set and cure. After curing, it was observed that the cast piece was light in weight and strong.

Figure 4.3.1 Final cast piece from experiment one
Source: (by the investigator)

Observation of experiment two: The reactions of groundnut shell powder bond

with styrofoam and petrol

The mixture was highly plastic and flexible. The work was kept outside to set because

fowls were eating it yet it took a longer time to set and cure because of its nature. Due

to the flexibility of the material, the mould was removed without causing any damage to

it. The cast piece came out with all the details in the mould and it was very stronger

Figure 4.3.1 Final cast piece from experiment two
Source: (by the investigator)

Observation of experiment three: The reactions of groundnut shell powder bond

with white glue

The researcher observed that the material did not set well before the mould was

removed and there was no weight to compress it, which resulted in some casualties on

the cast piece. After curing, the work was strong.

Figure 4.3.3 Final cast piece from experiment three
Source: (by the investigator)

Observation of experiment four: The reactions of groundnut shell powder bond with contact adhesive type-99 glue

Apart from the synthetic resin, it set faster than the other works. The fine details in the mould did not come out as expected after casting. The surface of the work was a bit rough. The cast piece is lighter in weight but not very strong as compared to the other binders.

Figure 4.3.4 Final cast piece from experiment four
Source: (by the investigator)

Observation of experiment five: The reactions of groundnut shell powder bond with synthetic resin

The work sets within 10 minutes and the mould was removed. All the details in the mould came out well. The cast piece is stronger than the works in other binders.

Figure 4.3.5 Final cast piece from experiment five
Source: (by the investigator)

4.4 Findings for research question two: How will the bond groundnut shell powder be used to model, cast board and carve a sculpture with students in senior high school?

Modelling with the Bond Groundnut Shell Powder

The plasticity of groundnut shell bond with white glue was like concrete. The texture of bond groundnut shell is not fine as compared to clay, which makes it less plastic, but it could also be manipulated into any form. It is better to have an armature when using

bond groundnut shell powder for direct modelling. Details of the torsos were achieved through direct modelling in bond groundnut shell. The groundnut shell powder was bond with white glue. It was not very plastic but the students were comfortable and enjoyed using it. Some of the final year students said they would like to use the material for their WASSCE project works. Three female torsos were produced. The models were stronger and lighter than cement, POP or clay works.

**Figure 4.4.1 Final work (torso) modelled directly in bond groundnut shell powder
Source: (by the investigator)**

Casting a Board with the Bond Groundnut Shell Powder

A wooden frame (mould) with plastic sheet was used to cast the board. The Groundnut shell powder was bond with white glue from which the board was cast for carving. Like wood, the cast board was strong and suitable for carving a plaque or any other relief sculpture.

Figure 4.4.2 Cast board in groundnut shell powder bond with white glue

Source: (by the investigator)

Carving of the Bond Groundnut Shell Powder Board

The groundnut shell powder board was not hard but soft enough to be carved manually. Unlike wood, the grain groundnut shells board had no direction yet it was not difficult to carve. Groundnut shell powder board resembles like wood in colour, texture and weight. The tools and procedures for carving wood were employed in carving a plaque in groundnut shell powder board.

Figure 4.4.3 Final work (plaque) carved in groundnut shell powder board
Source: (by the investigator)

Findings for finishes and finishing methods of works produced in groundnut shell powder

Various kinds of finishes and finishing methods for sculpture works in other materials especially wood could be used for works produced in groundnut shell.

4.5 Findings from interview of respondents (feedback) after activities

Table 4.6 Findings from interview

Findings from the interview show that:

Total Number of Respondents	Forty-Four (44)		
Question	**Response**	**Number of Responses**	**Percentage (%)**
1. Is bond groundnut shell plastic enough to be manipulated to any form?	Yes	44	100%
	No	-	-
2. Are sculpture tools and equipment used for other materials applicable when working with groundnut shell?	Yes	35	79.5%
	No	9	20.5%
3. Does the texture of bond groundnut shell affect the decoration of a work?	Yes	5	11.4%
	No	39	88.6%
4. Sculpture works produced in groundnut shell resemble work produced in?	Clay	-	-
	Cement	-	-
	POP	-	-
	Wood/sawdust	44	100%
5. Can you use finishes such as varnish, acrylic or oil paint for sculpture works produced in groundnut shell?	Yes	44	100%
	No	-	-
6. Do you enjoy using groundnut shell for modeling, casting and carving of sculpture?	Yes	32	72.7%
	No	12	27.3%
7. Would you like to use groundnut shell for your WASSCE project work?	Yes	32	72.7%
	No	12	27.3%

- Forty-four (44) respondents representing hundred percent (100%) agreed that bond groundnut shell is plastic enough to be manipulated to any form. Finishes for sculpture works in other materials can be used for works produced in groundnut shell and that groundnut shell work resembles saw dust or wood sculpture.

- Whiles thirty-five (35) respondents representing seventy-nine point five (79.5%) agreed that sculpture tools and equipment for other material can be used when working with groundnut shell, nine (9) respondents representing (20.5%), disagreed.

- Thirty-nine (39) respondents representing eighty-eight point six percent (88.6 %) agreed and five (5) representing eleven point four (11.4%) disagreed that the texture of bond groundnut shell does not affect the decoration of a work.

- Thirty-two (32) respondents representing seventy-two point seven percent (72.7%) agreed whiles twelve (12) representing (27.3%) disagreed that they enjoyed using groundnut shell for modeling, casting and carving of sculpture and will like to use it for their WASSCE project work.

Summary of the interview

According the respondents, groundnut shell is a suitable material for sculpture. They enjoyed using it because it was not difficult for them to manipulate bond groundnut shell to different forms by using sculpture tools. Groundnut shell works resemble works produced in sawdust or wood and has very attractive texture and colour. Wide range of finishes and finishing methods can be applied to them. They are stronger and lighter than works in conventional materials such as clay, cement or POP

4.6 Appreciation of selected works

Appreciation in art refers to the cognition of general characteristics that classify great works of art. It refers to analyzing the form of an artwork to general audiences to enhance their enjoyment of such work (Yundle, 2018).

According to Yundle (2018), art appreciation involves; Description (physical qualities and formal way of construction), Analysis (close study of the physical qualities in subjective manner), and Interpretation (meaning of work in relation to historical, religious, environmental, content, aesthetics and cultural value of the work).

4. 6.1 Appreciation of work – Ndewura Jakpa

Figure 4.6.1 'NDEWURA JAKPA', 25cm diameter, by students of Salaga SHS
Source: (by the investigator)

Description

'NDEWURA JAKPA' is a Gonja traditional symbol, cast in groundnut shell bond with Styrofoam and petrol mixture. This work a relief sculpture produced by the students of Salaga Senior High School in November, 2017 and measures twenty-five centimeters diameter. The work is in circular form and portrays the right arm holding a spear in readiness to throw. The arm with spear is centered in the middle and the background is textured with lines.

Analysis

The students employed modeling and casting techniques in executing the work. The work was first modelled in clay with all the details before plaster of Paris was applied on it to obtain mould for the casting. Groundnut shell was bond with styrofoam and petrol mixture as the casting medium. The work shows a realistic right arm throwing spear even though, it is not painted with life like colours. Some of the elements and principles of art such as line, shape, colour, texture, balance, rhythm, unity, proportion etc. can be seen in the work.

The circle around the arm holding spear in the work are smoothened and varnished to show visual texture. The background painted red was decorated with curve lines crossing one another. The work suggests throwing of spear as muscles of the upper arm bulge out with veins around the wrist closed to the fist of the upper arm holding the spear firmly, in the process of throwing to depict rhythm (movement). The size of spear is proportional to the arm and placed in the middle of the circle to show balance. The metal part of the spear is triangular in shape with a sharp pointed tip.

Interpretation

The arm-holding spear symbolizes Ndewura Jakpa, also known as the red hunter. He was a warrior and a founder of Gonja Kingdom according to the history of Ghana. The red colour seen in the work represents bravery. This work can be used by Gonja King, chief and other individuals in as a decorative piece which will educate people about their history. The artists have been inspired by the culture and traditions of Gonja people at Salaga in the Northern Ghana.
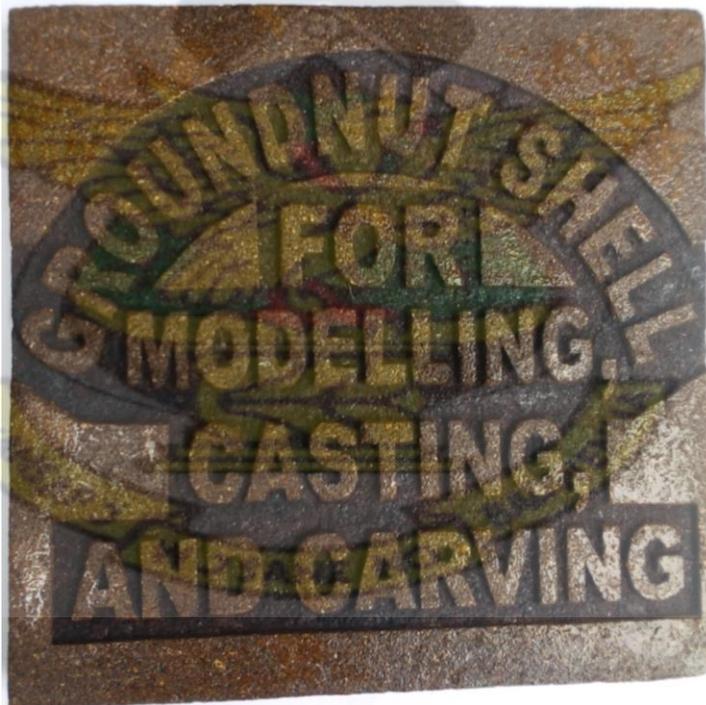
4.6.2 Appreciation of work – Gold in Shit

Figure 4.7.2 'GOLD IN SHIT', 27cm square, by Students of Salaga SHS
Source: (by the investigator)

Description

'GOLD IN SHIT' is a plaque carved in a cast board in groundnut shell powder. This work was made by students of Salaga Senior High School in November 2017 under the supervision of the researcher and measures 25cm square (length and breadth). The work depicts carved plaque with inscription 'GROUNDNUT SHELL FOR MODELING, CASTING AND CARVING'. Groundnut shell is inscribed in a circular form whiles the rest of the text in horizontal form.

Analysis

The students employed casting and carving techniques in executing the work. The board cast in groundnut shell powder was bond with white glue, which makes it strong and soft enough for carving. Carving of the letters is very accurate and the carved area painted with a deep brown colour that makes the inscription to standout clearly. The positive areas that were not carved, have the original colour and texture of the bond groundnut shell powder, which resembles sawdust board or wood. There is balance, rhythm, unity, proportion and other principles of art in the work. Varnish is applied onto the work protect and enhance its appearance.

In the work, 'GROUNDNUT SHELL' is inscribed in a curved line whiles remaining part of the entire inscription 'FOR MODELLING, CASTING, AND CARVING' in horizontal format. The boarder designs at the top and bottom of the inscription are varied but the right and left sides are identical. Under the inscription 'GROUNDNUT SHELL' are two identical geometric shapes at the right and left sides of the word 'FOR' and the shape on top look like semi-circle. There is variety in the work as the

inscriptions are arranged with shapes to also show proportion and balance. The arrangement of the inscription 'GROUNDNUT SHELL' balance with the rest of the text. The fine texture of the board can be seen and felt.

Interpretation

'GOLD IN SHIT' as the work is titled, implies that groundnut shell is normally thrown in the environment like shit but when used to produce sculpture works and other things of great value to the society, can lead to income generation. Groundnut shell inscribed in a circular form suggests an artist's ability to turn groundnut shell (waste) into money through the application of various techniques of sculpture productions. The work can be used as a decorative piece for offices or living places. Also, it can be used to educate other about the uses of groundnut shell. The artists came from the Northern part of Ghana where groundnut shells have been discarded abundantly in the environment.
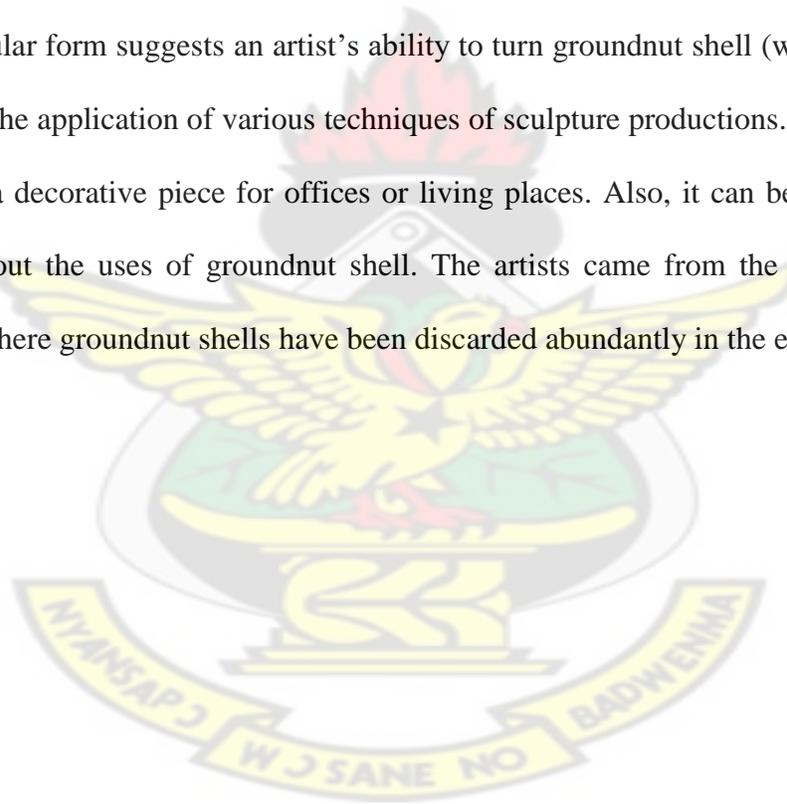
4.6.3 Appreciation of work – Unknown Torso

Figure 4.7.3 'UNKNOWN TORSO', 25cm high, by students of Salaga

Description

'UNKNOWN TORSO' is a statuette of about twenty 55cm height together with the base, produced by students of Salaga SHS in the Northern Ghana. It depicts a nude female Negro torso with protruding breast and buttocks resembling an adolescent girl. The abdomen is small with medium hips and buttocks.

Analysis

The figure is in motion as it tilts at the left side with the right upper leg in front. There is space in between the legs. This work was modelled directly in groundnut shell powder bond with white glue. Metal rod or binding wire was used to create an armature upon which the work was modelled. The material was added onto an armature bit by bit and manipulated with knife, spatulas, and other modelling tools to produce the work. The work was smoothened by using sand papers before applying varnish on it as a finish to enhance its aesthetic qualities. Balance, rhythm, unity, proportion, and other principles of art are seen in the work.

The work is asymmetrically balanced because, the right upper leg and the left shoulder are placed in forward motion whiles the left leg and the right shoulder have moved backwards to show rhythm. There is balance, proportion and unity in the way shapes or forms of the breast, hips, buttocks etc. are depicted.

Interpretation

'UNKNOWN TORSO' is a symbol of beauty. It educates people about the beauty of an African woman. African women are being admired by their beautiful shaped hips and buttock. 'UNKNOWN TORSO' is an indoor sculpture and could be used to decorate offices or living rooms. It will educate people about the qualities relating to the beauty of a woman among the Ghanaian and other African cultures.

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Overview

Chapter five as the final chapter consists of summary findings, conclusions on groundnut shell as an alternative sculpture material for modelling, casting and carving and recommendations for the Ministry of Education, sculpture teachers and students as well as researchers and other Stakeholders.

5.2 Summary

Objectives of the study are to:

1. To experiment groundnut shell powder with selected binders which react positively.
2. To model, cast a board and carve sculpture works in bond groundnut shell with students in Salaga Senior High School.

Groundnut is also known as peanut, earthnut, Chinese nut or goober and groundnut shell is called groundnut hull or groundnut husk. Groundnut cultivation started around 8000 years ago and 500 years later, the plant reached Mexico where it spread to North America, China, and Africa. China ranks first among the top-ten-biggest groundnut producing countries in the world and Nigeria ranks first in Africa. Ghana ranks tenth in the world and fourth in Africa.

The main byproduct of groundnut processing factories in Ghana is groundnut shell, which consists of fragmented shells with variable amount of whole or broken kernel. In Ghana and other groundnut producing countries, groundnut shell is normally burnt or dumped to deteriorate naturally which causes environmental pollutions. Utilization of groundnut shell to feed livestock helps alleviate environmental burdens in groundnut producing countries.

Groundnut shell is composed of lignin, cellulose, proteins and carbohydrates. The percentage composition of the components is protein (8.2%), lignin (28.8%), cellulose (37.0%) and carbohydrate (2.5%).

The common materials for teaching modeling, casting, and carving at Salaga Senior High School are clay, wood, plaster of Paris, and cement. These materials are very expensive and using them materials comes with so many demerits. For example, clay models must be fired to become permanent. Clay and wood works crack in the process of drying due to the harsh weather condition in the Northern Region.

According to the literature available, people have used groundnut shell for the production of fuels, ply woods, soap, electric power, art work and others but no one has ever used it for modelling, casting, and carving of sculpture. Steve Casino and other few artists who have used groundnut shell for art production did not use shells that were completely damaged and the techniques they employed were assemblage, construction and painting. No doubt, there was the dire need to improve and use the material as for sculpture production to create newness and innovations in order to heighten creativity among the SHS sculpture students.

Summary of Major Findings

The thesis has revealed that:

- Groundnut shell is non-toxic and has some nutritional values but it is advisable to protect the nose when milling it or sanding a work because it is not good to inhale the dust.

- The tools, equipment, and techniques used for other sculpture material are applicable when working with groundnut shell.

- Groundnut shell powder can be bond with cassava starch, styrofoam, white glue, contact adhesive glue type 99, and synthetic resin for sculpture production

- Sculptor can choose any of the binding agents depending on the purpose or technique that will be employed. For instance, white glue could be used if the sculptor intends to carve an indoor sculpture.

- Bond groundnut shell powder is plastic and can be manipulated into any form.

- It requires an armature and a little patience to produce a direct model in bond groundnut shell.

- A work in groundnut shell powder can withstand insect or weevil attack, rain and other environmental elements when styrofoam or resin is used as binding agent. It was observed that fowls did not eat excess groundnut shell bond with these binders and does not also absorb water after setting.

- Unlike wood, the grain groundnut shell powder board has no direction but it requires a little pressure to carve. It was easy to carve using a cutter and small gouges.

- Groundnut shell powder works resembles saw dust or wood carvings. Varnish, lacquer, paint, and other finishes for wood sculpture can also be used for works produced in groundnut shell.

5.3 Conclusions

1. Through this study, the researcher was able to use groundnut shell powder to teach modelling, casting, and carving at Salaga Senior High School. The researcher also helped students to produce sculpture works with the material. The finished works are strong and easy to transport.

2. Using groundnut shell as an alternative sculpture material rather than dumping or burning to a very large extent, will reduce environmental pollution, deforestation and improve groundnut cultivation in Ghana.

3. The researcher was able to use groundnut shells especially the damaged ones that Steve Casino and other artists did not use to model, cast, and carve sculpture works with students.

4. The study has made a significant contribution to knowledge, because it is a pioneering project. No one has ever used groundnut shell to model, cast or carve a sculpture work in Ghana or elsewhere around the world.

5.4 Recommendations

The following recommendations if adopted may help immensely:

1. Sculpture teachers in schools, lecturers at the tertiary institutions and students should make use of groundnut shell powder for teaching and learning modelling, casting or carving since it is inexpensive and also suitable material for sculpture.

2. Sculpture industries in Ghana and around the world should make use of groundnut shell for sculpture production that will help reduce cost, deforestation, environmental pollution and also improve the cultivation of groundnut in the country.

3. Curriculum Research and Development Division (CRDD) of Ghana Education Service should include groundnut shell in the teaching syllabus as one of the major sculpture materials for institutions of learning.

4. Ministry of Education and Ghana Education Service in consultation with heads of schools should organize workshops for sculpture teachers in line with utilization of groundnut shell for teaching sculpture.

5. Future researchers should conduct further studies on other waste materials that can bind groundnut shell for sculpture production.

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APPENDIX

Interview Guide

Interview Guide used by the moderator or researcher on the topic: GROUNDNUT SHELL AS AN ALTERNATIVE SCULPTURAL MATERIAL FOR MODELLING, CASTING AND CARVING: THE CA SE OF SALAGA SENIOR HIGH SCHOOL, GHANA

1. Is bond groundnut shell plastic enough to be manipulated to any form?

2. Are sculptural tools and equipment used for other materials applicable when working with groundnut shell?

3. Does the texture of bond groundnut shell affect the decoration of a work?

4. Work produced in groundnut shell resembles more like what?

5. Are the finishes for works produced in other sculptural materials to works in groundnut shell?

6. Do you enjoy using groundnut shell for sculpture production?

7. Would you like to use groundnut shell for your WASSCE project work?