EVALUATION OF FACILITIES AND MATERIALS FOR TEACHING CERAMICS IN SOME SELECTED COLLEGES OF EDUCATION IN NORTH - EAST GEO- POLITICAL ZONE OF NIGERIA

BY

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DECLARATION

I hereby declare that the thesis entitled "Evaluation of Facilities and Materials for Teaching Ceramics in Some Selected Colleges of Education in North-East Geo-Political Zone of Nigeria" has been written by me in the Department of Industrial Design of the Faculty of Environmental Design under the Supervision of Mr. M. S. Aluwong and Prof. A. M. Ahuwan. The information derived from the literatures has been duly acknowledged in the text and a list of references provided. No part of this thesis was previously presented for another degree or diploma at any University.

CERTIFICATION

This project entitled "Evaluation of Facilities and Materials for Teaching Ceramics in some selected Colleges of Education in North - East Geo-Political Zone of Nigeria" by Mamza, Alewai Jidai meets the regulations governing the award of Master of Art in Industrial Design of Ahmadu Bello University Zaria, Nigeria, and it is approved for its contribution to knowledge.

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ABSTRACT

This study was designed to evaluate the status of facilities, equipment and materials for effective teaching of ceramic education in Colleges of education in North - East Geo- Political Zone of Nigeria. The study evaluated the availability and functionality of facilities, equipments and materials used for teaching ceramic education in the Colleges of Education. Four research questions, four objectives were stated and four null hypothesis were formulated and tested. Textbooks, Dictionaries, Journals, Encyclopaedias, theses, magazines, conference papers, photographs, internet, verbal information, personal observations were considered and acknowledged as means of references. The survey research method was used for the study. A total of eighty respondents ceramic students, were randomly selected out of one hundred and forty - seven using stratified random sampling technique. The instruments used for the study were questionnaires and checklist. The questionnaire and checklist were used as the main instruments for the study Statistics of percentages was used to describe the characteristics of the respondents, while chi-square was used to test the null hypothesis at 0.05. 56 (69,4%) of the respondents agreed while 24 (30.6%) respondents disagree that there are facilities, equipment and materials. The calculated χ^2 is 6.05, while the % critical value is 7.82. This result shows that the χ^2 calculated value is less than χ^2 critical value. Therefore, the null hypothesis which states that there is no significant difference in the opinion of the respondents towards availability of facilities, equipment and materials in the colleges of education is retained. Twenty - eight (35%) of the respondents agree that the materials and equipment are adequate, while 52 (63%) disagreed. The obtained χ^2 was 39.32, which was greater than the critical χ^2 of 7.82. Therefore the null hypothesis that states that there is no significant difference in the opinions of respondents on the adequacy of existing materials and equipment is rejected. Twenty - three (28%) of the respondents agree, while 59 (72%) disagreed about the proper functioning of existing equipment. The obtained χ^2 was 24.6 while the critical χ^2 was 7.82. Therefore the null hypothesis that states that there is no significant difference in the opinions of the respondents towards the proper functioning of existing equipment and materials is rejected. From the analysis of the responses it was observed that there are facilities, equipment and materials for teaching ceramics in the colleges. These materials and equipment are however, not adequate for the teaching and learning needs of the students in the colleges. It was also observed from the responses in table 4.15 that the problems associated with the use and maintenance of equipment, facilities and materials are insufficient equipment, poor standard of equipment, the poor culture of acquiring equipment to meet the growing demand for them, dependence on manual production instead of mechanized production and the equipment are old and outdated making the acquisition of their spare pans very difficult. It could be concluded that without adequate provision of equipment, facilities and materials for the teaching of ceramics, proper teaching and learning will be hampered and in some colleges made almost impossible.

Even with the existing equipment and materials, teaching and learning task will become difficult for both lecturers and students if they are not functioning properly or if they are inadequate.

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CHAPTER ONE

Introduction

1.1 Background to the Study

In every teaching and learning institution, facilities, instruments, materials, equipment and manpower for instruction are very important for the effective teaching and learning process. Famwang (2003) stated that the search for aids to make teaching and learning easy and effective has been long among educators. The teacher needs to know which instructional materials and pieces of equipment are appropriate and relevant for the teaching-- learning situation. Owen (1973) stated that instructional materials are an educator's tools. They are used in classrooms or studios throughout the world to improve teaching and effect learning. Everything should be done to get the educational institutions to fulfill their potentials, not by providing the schools with endless - but in the end trivial -options, but by supplying effective alternative for individual learners.

The National Policy on Education (NPE) (2000) stated that the minimum qualification for entry into the teaching profession shall be the Nigeria certificate in Education (NCE). However, according to Ewule (2004) investigations of current ceramic teaching in Nigerian schools and colleges has been found to be unscientific, poor and not organized to produce sound knowledge ceramic teachers. This could be due to the lack of modem equipment and adequate materials in the Colleges of Education for proper foundations of teaching and learning.

Colleges of Education would play a vital role if they are adequately equipped with equipment and materials for teaching and learning. Some of these equipment and materials according to Alasa (2005) include kilns, potter's wheels, glazes, modeling tools, clays, and so on. These he stated are inevitable aids that enhance and facilitate the teaching and production

processes in ceramics. The use of equipment and materials in the Colleges of Education is however hampered by some factors. These factors according to Ewule (2006) are unavailability of basic equipment, high cost of production of the materials and exorbitant prices of available pieces of equipment. Ajayi and Chindo (2005) also pointed out that many higher institutions responsible for the training of graduates in the country lack even the basic training aids such as kilns, throwing wheels and so forth. Other problems identified by Idowii (2006) include lack of fund to carry out necessary research especially in higher institutions of learning of which he advised the government at various levels to make enough funds available to carry out the necessary research that can lead the advancement of the profession. Training of Teachers (minimum) seems to be underrated and students do not appear to be adequately sponsored. Most students offer the course as a stepping stone to other professions such as Banking, Law, etc. Lack of Resource Centers where research materials laboratory for research and research pieces of equipment such as high temperature kiln are available is yet another challenge.

Ajayi and Chindo (Ibid) also identified the shortfall in skilled manpower and modern technology, research and development as well as inadequate and reliable ceramic infrastructure. According to them the present curricula operated in ceramic training institutions in the country are too shallow, narrow and lack contents for the development for ceramic technology. This to them is a misnomer and portrays the course more of art and design, which is meant to beautify the physical environment. They concluded that this has made educationist and policy makers in education to see and misconstrue ceramics as nothing different from the art of beautifying the physical environment Whereas Chaffers (1965) and Arayela (2006) pointed out that

pottery/ceramics is the mother of all art. The development of pottery/ceramics was a milestone in human history.

According to Ahuwan (2003) Nigeria that aspires to industrialization is over-burdened by the paradox, where they adore ceramics ware on their alls, toilets, roofs and tables but do not appreciate their child studying ceramics in Universities, Polytechnics or Colleges of Education. This study evaluates the availability, adequacy, functionality and maintenance of the ceramic equipment and materials in Colleges of Education in the North-East Geo-Political zone of Nigeria.

1.2 Statement of the problem

The lack of adequate facilities, equipment and materials is one of the problems affecting the teaching of ceramic education in most of the Colleges of Education today. According to Gukas (2005) colleges are supposed to have adequate basic ceramic equipment and materials for effective teaching and learning in the colleges.

1.3 Research Questions

The following research questions were developed to guide this study:

i. Are there available facilities, equipment and materials for teaching ceramics?

ii. Are the equipment and materials adequate?

iii. Are the equipment and materials functioning properly?

iv. What are the major problems associated with the use and maintenance of equipment and sourcing of materials in the colleges of education?

1.4 Basic Assumptions

For the purpose of this study, the following assumptions were made:

i. The Colleges of Education had facilities, pieces of equipment and materials for teaching ceramics
ii. The pieces of equipment and materials are adequate
iii. The pieces of equipment are functioning properly
iv. The maintenance of the pieces of equipment is effective.

1.5 Hypothesis

Major Hypothesis:

There is no significant difference between the opinions of respondents on the availability, adequacy, functionality and maintenance of facilities, equipment and materials for teaching ceramics among the Colleges of Education in the North-East Geo-political zone of Nigeria.

Sub Hypothesis:

1. There is no significant difference in the opinions of the respondents on the availability of facilities, equipment and materials in the Colleges of Education.
2. There is no significant difference in the opinions of the respondents on the adequacy of existing facilities, equipment and materials.
3. There is no significant difference in the opinions of the respondents towards the proper functioning of the existing facilities, equipment and materials.
4. There is no significant difference in the opinions of the respondents on the maintenance and use of existing facilities, equipment and materials.

1.6 Objectives of the Study

The objectives of the study are:

i. To ascertain the availability of facilities, equipment and materials in the Colleges of Education in the North-East Geo-political zone of Nigeria.
ii. To determine the adequacy of the existing equipment and facilities in the College of Education in the North-East Geo-political zone of Nigeria.
iii. To find out if the equipment and materials are functioning properly in the Colleges of Education in the North-East Geo-political zone of Nigeria.
iv. To identify the major problems associated with the use and maintenance of these equipment and materials in the Colleges of Education in the North-East Geo-political zone of Nigeria.

1.7 Scope and Limitation of the Study

This study was limited to assessing ceramic facilities, equipment and materials in the four selected Colleges of Education in the North-East Geo-political zone of Nigeria.

These include College of Education, Gashua, Yobe State; College of Education, Hong, Adamawa State, Kashim Ibrahim College of Education, Maiduguri, Borno State and Federal College of Education (Technical) Potiskum, Yobe State.

1.8 Purpose of the Study

The purpose of the study is to find out the availability, adequacy, functionality and maintenance stance of the equipment and materials in some selected Colleges of Education in North-East Geo-political zone of Nigeria.

1.9 Significance of the Study

The outcome of the study may provide data on the status of ceramic educational facilities, pieces of equipment and materials in the North-East Geo-political zone. The bulk of (lie thesis will equally be a reference material for educational administrators, planners, teachers and parents, colleges of education, resources persons, state and federal government. This will in no small way assist them in the proper planning of the Ceramic Education Programme. It may also assist planners in education to formulate strategies that may ensure that the adequate provision of facilities, equipment, and materials and to find out the reasons for the dearth of facilities in order to avert them These contributions will help the individuals, organizations and nation grow healthy, economically, socially and educationally sound. It also creates room for decision making. It will help to strengthen the foundation of students all over the nation and in the world at large.

The result of the study could be used to develop possible solutions and suggestions that can contribute to making teaching and learning to be effective.

CHAPTER TWO

Review of Related Literature

Introduction

The purpose of this chapter is to review literature related to the study. The chapter is organized under the following sub-headings: Importance of Ceramics; The Establishment of Colleges of Education in Nigeria; The Colleges of Education for the study; Ceramic Teaching in Polytechnics and Colleges of Education; Ceramic tools and pieces of equipment; Clay; Ceramic materials; Sources of getting Ceramic Equipment and Materials; and maintenance of Ceramic Equipment and Materials, Managing the Material Resources; Resources Maintenance and Summary.

2.1 Importance of Ceramics

Ceramic materials are very important in today's society. Tiles join other construction materials to embellish our towns and cities Ali, (2004). Brick is the only building product that will not bum, melt, peel, warp, dent, rot, rust or be eaten by termites. Tiles are used in applications such as flooring, walls, countertops, and fire places. The electronics industry would not exist without ceramics because ceramics are excellent insulators, semi-conductors and magnets (Opoku, 2006 and Arayela, 2006). Ceramics can also be used as a form of artistic or cultural expression/heritage. Bassey, (2006); Bakinde, (2006) and Ada, (2006) affirmed the role of ceramics in vocational enterprises and career development, cultural development and promotion, socio-cultural, economic empowerment and capacity building, and its contribution to industrial and technological development and promotion in Nigeria. Alkali (2003) stated that

ceramics industry has played a tremendous role in the development of mankind by producing useful ceramic products, like table wares, electrical insulators roof tiles, clay pipes and so on

2.2 The Establishment of Colleges of Education in Nigeria

The origin of Colleges of Education in Nigeria dates back to the work- of the Ashby Commission in 1959. The commission had, among other things, observed that many teachers were uncertified and improperly trained (FGNJ: 1960. 41). This observation was followed by a recommendation for massive expansion of intermediate education of teachers aimed at upgrading the existing teaching force in the primary schools and the supply of trained teachers for the expansion of secondary education.

The emergence of the first four Advanced Teachers Colleges by the early 60's to produce holders of the Nigerian Certification in Education was the outcome of government reaction to the Ashby report. The Advanced Teachers Colleges were the progenitors of the current Colleges of Education. The College of Education project which started with 4 institutions in 1962 had expanded to 44 within two decades and further to 54 by 1990. Today, there are 75 Colleges of Education in Nigeria. Adesina (1977) had contended that there persisted an imbalance in the system and the enrolment into teacher training institutions. The alarm sounded by Adesina over thirty years ago still resonate powerfully with us today such that the teaching profession has become endangered specie (FGN, 2004). Although there is hope for improvement when there is life, there is need to study the perceived problems of ceramics equipment and materials in Colleges of Education in the North-East Geo-political zone of Nigeria bearing in mind the qualities of education and the quality of teacher education.

2.3 The Colleges of Education for the Study

The College of Education Gashua was established in 1986 in Gashua, Yobe State. Federal College of Education (Technical) Potiskum was established in 1988 in Potiskum, Yobe State. Kashim Ibrahim College of Education Maiduguri was established in 1976 in Maiduguri, Borno State. College of Education Hong was established in 1989 in Hong, Adamawa State. These colleges were established for the following purposes;

a. To provide a course of study, training and research in arts language and the sciences leading to the award of the Nigerian Certificate in Education (NCE).

b. To provide holders of NCE who will teach in the primary and post-primary institutions in the states.

c. To promote through teaching, research and other means, the advancement of knowledge and its application to the needs of the States and the Communities (NCCE 1996).

Since ceramic education has been established in these colleges, the basic required facilities, equipment and materials need to be provided and to be evaluated from time to time to see that the teachers and students affirm to learning and teaching effectively for the betterment of the institutions and the communities.

2.4 Ceramic Teaching in Polytechnics and Colleges of Education

According to Ewule (2004) an advisory council was recommended by MacDonald (1970) to be established to see to the day to day running of the Diploma/ National Certificate in Education (NCE) Programme. The responsibilities should be to:

a. Administer the new award.

b. To be responsible for the approval of the courses from the academic point of view.

c. To arrange and organize examinations.

MacDonald suggested that the council should be under the ministry of education. The ministry of education should set up the national council for Diploma/ National certificate in Education (NCE) in art and design, which will be headed by a chairman who will ensure the relevance of the Diploma/National Certificate in Education (NCE) in the polytechnics and colleges of education. This body will oversee the recruitment of relevant qualified teachers. An inspectorate division should be formed to visit colleges for inspection. When adequate pieces of equipment and materials are properly set in this way, the teaching and learning will be enhanced in an orderly manner.

She continued that graduates from these Polytechnics and Colleges are either sent to primary or secondary schools to teach art. With the good background of the teachers, the teaching they give will be fundamental and sound. The university programme will also absorb the graduates from these Polytechnics and Colleges of Education to read ceramic and other subjects. These students from the Polytechnics and Colleges of Education will be prepared to go back after graduation to teach in primary and secondary schools (Ewule, 2004). Properly trained

teachers will end up teaching properly with the provision of required teaching facilities, equipment and materials.

2.5 Basic Ceramic Equipment

Alasa (2005) stated that ceramics tools and equipment are inevitable aids that enhance and facilitate the production processes in ceramics. Norton (1956) stated that the pieces of equipment are; Scales, Screens, Magnetic Separators Filters, Ball mills, pug mills, wet pans, wedging table and storage facilities. Others are: Bowls, Bench, Tools, Wheel, Jigger, Dryers, Spray Gun, Spray Booth, Kilns and Kiln furniture.

Nelson (1978) stated that studio equipment are as follows: Ceramic Kilns, Potters Wheel, Clay Mixers, Slab Rollers and Extruder and Gla^e Room equipment. Other equipment he stated are: Scales, Banding Wheels, Craft Tool Kit of common pottery tools and so forth. Alasa (Ibid) listed some basic ceramic equipment as follows: Clay mixers; dryers; kiln; ball mill; porcelain mortar and pestle; brass sieve; spray booth; throwing wheel; ware rack; shop lift; temple beam balance; spring balance; standard pyrometer; bowls/buckets; spraying gun. Hogan (1973) stated that as a starter, the standard equipment below will be used from the start to the finish of a piece. These equipment are: rolling pins, calipers, brushes, sgraffito tool, fettling knife, needle or pin, wire cutter, ribs, wire, loop and ribbon, scraper, sponges, modeling tools, bats, banding wheels, wedging table or board, paddles, pot lifters, chuck and ruler. She also pointed out there are miscellaneous equipment including those listed below: Plastic bags, wooden sticks, sheets of wood, atomizers kitchen pads and plaster.

Standard equipment should be provided to the Colleges of Education in the North East Geo-position zone of Nigeria for refortified teaching and learning in these colleges and to give

the students insight understanding of them and their uses. Also they could use them during their practical lessons because each of these equipment has its functions in ceramic teaching and learning. Hogan (Ibid) did not include kiln in her list which is one of the most important equipment in ceramics.

2.5.1 The Potter's Wheel

The potter's wheel has been in existence for a long time ago without an exact date. Cardew (1970) made blunt conclusion that "Nobody knows exactly when the potter's wheel was first invented". According to Onu (2006) potter's wheel is not only one of the testicles that constitute the potency of pottery but one of the central pillars that suspend its beams. Onuzulike (2004) described the potter's wheel as a revolving mechanical device, with a flat disc-like platform mounted on a rotating shaft or spindle, which facilitates the work of a potter in the Grafting of hollow, symmetrical forms in clay. There are many types of wlieels available, basically they fall into two categories: kick wheels (those powered by the potters feet) and electrically driven wheels. Each has its advantages and disadvantages. Hogan (1973) stated that the potter's wheel is one of the basic equipment required by the potter for more and stress-less production thought it is costly obtained. The various types of wheel include; a. The Standing kick wheel b. Seated kick wheel c. Electric wheel.

If you learn on the kick wheel, you become familiar with the throwing presses by having to use your whole body. At the same time, you are developing hand-foot coordination. Kick wheels are quieter and generally less expensive than electric wheels of comparable quality.

Electric wheel is usually smaller and lighter than a kick wheel. You can leam more quickly on it because, not having to worry about keeping the wheel turning with your foot, you

can give full attention to your hand movements. And, since much of the work is done by the wheel, the potter can channel more energy into making pots. Electric wheels are a boom to the production potter who must turn out many pieces quickly.

a. The Standing kick wheel: The 36kg (801b) flywheel is positioned immediately beneath the working tray where it is completely encased for maximum safety. In addition, adjustable anti-skid feet have been incorporated at the base of each leg to aid levelling or marginally alter the height of the wheel head from the floor. A front mounted treadle that can be operated with either foot activates the roden, self-aligning ball bearings, which ensure smooth, silent running with the minimum of maintenance. Carrying handles fitted to the sturdy steel framework on other side of the working tray, make this an easy wheel to move (Pottery crafts limited, 1990). This type of wheel is affordable and can be maintained at lower cost but it is not very suitable for women. So when purchasing for this type of equipment there is need to be considerate.

b. Sealed kick wheel: This wheel is fitted with a 15 diameter (38 mm) cast iron wheel head to give excellent control and free running. A large capacity one-piece plastic splash tray, complete with waste run of pipe is standard; whilst the padded upholstered seat ensures an effective and comfortable working position. The machine is ideal for beginners, School and Colleges use and for the experienced potters who may prefer to use a kick wheel (Pottery crafts limited, 1990). Seated kick wheel is actually comfortable to use just as the maker indicated.

In the same line with Pottery Crafts limited (1990), it is advisable for Colleges to go for this type of wheel because even their maintenance is not much expensive as long as it is being cleaned immediately after use. It is equally good for beginners in the Colleges so that the students can learn to handle and put in their best to become professionals.

c. *Electric wheel:* Electric wheel robust highly polished wooden cabinet with interregna! worktop shelf, spacious rigid wheel try with large diameter waste outlet and adjustable upholstered seat for maximum comfort. Other facilities on the wheel include splash proof electrics with overload motor protection and high-powered drive with accurate and sensitive speed control producing speeds up to 300 rpm. The electric wheel is engineered for long life and low maintenance with a long working load capacity of up to 23kg (501b) (Pottery Crafts, 1990). Electric wheels are generally faster in production and reduce physical stress. But electric wheels can also delay work when there is electric power cut-off, especially in nations where there is no guarantee of electricity.

The Super 70 mark is another type of electric wheel. It has a tough metal case with strong plastic wheel tray making it a good workhorse for both students and professional potters. The foot speed controller can be converted to hand control with minimum adjustment. The powerful motor provides speed throughout the range. Adjustable footrests allow the potter to stand astride the wheel whilst throwing tall pots. The seat is also adjustable. The wheel needs little maintenance or servicing and is designed to have a long working life (Pottery Crafts, 1990). This type of wheel though, it is electrical, there is need to get sample for the students to have knowledge about them and even with the school or college generator, the teacher/ lecturer can operate and demonstrate its usage to the student. This ^yill motivate the young students that are eager to join the beautiful all round ceramic education as professionals.

2.5.2 The Origin of the Potter's Wheel

The potter's wheel has been in existence since long time ago without an exact date. Onuzulike (2004) stated that the earliest methods of building pots were pinching and coiling and that ancient people soon realized out of necessity, the convenience afforded by the use of a revolving base. He continued that this innovation helped them to produce pots much more easily without the usual stress of walking round and round them during the forming process.

Leach (1976) supported the observation that early potters began to develop the potter's wheel we know today from "a crude revolving base". This early device was essentially a flat disk, initially without any rigid spindle, and was rotated with hand. Onuzulike stated that all pottery traditions of the world used this "crude" revolving device. He continued that available written literature traces the origin of pottery to the Middle East (around the Nile and the Tigris-Euphrates Rivers) and the yellow Rivers in China. Nelson (1971) and Charleston (1975) have drawn attention to the development of primitive agriculture as an important watershed for the art of pottery making that provided utilitarian vessels for the gathering and storing of grains and other agricultural produce.

I.each (Ibid) hinted that the potter's wheel is known to have existed in Egypt from the commencement of recorded history, and in China and Europe it dates back to at least 200B.C. Rada (1964) suggested that disk rotating on a rigid spindle first appeared in Babylon, in about 4000B.C from where it spread to Egypt in about 3000BC and then afterwards to India, Asia minor and Cyprus, as well as to central Europe from Greece in about 500BC. Yet there has not been any concrete evidence to prove the use of the potter's wheel in Babylon around 4000 **BC.** Norton (1956) suggested that the potter's wheel "probably originated in the near East about the year 3000BC, but it took over a thousand years for its use to spread to Egypt, China and adjacent areas". Norton also recorded that the potter's wheel was used in China at about 2000BC, Egypt

1500BC and was later introduced to Europe by the Romans without probable date. Kenny (1976) opined that the potter's wheel existed 4000 years ago in Egypt.

Interestingly development of the potter's wheel has made a tremendous impact on the development of the art (or craft) of pottery all over the world. Technology develops in stages and accordingly with the traditions or cultures of the people concerned. The people or potters concerned prefer what perfectly worked for them. The development proceeded along different technical and innovative lines in different regions of the world. The regions arc stated in stages of probabilities at its origin as noted by Onuzulike (2004): The Malayan potter's Disk or Turn table, The Egyptian Hand-turned, and Leg-driven wheels, the Vietnamese potter's Hand-wheel, the Indian wheel, Chinese wheel driven by foot, and by hand, the potter's wheel, Russian Hand-driven potter's wheel, English potter's wheel Hand-driven by a potter's Assistant, The Japanese wheel and the German kick wheel respectively. The origin of the potter's wheel is addressed to be a probable matter. Cardew made a blunt conclusion that says nobody knows the exact date of the invention of potters' wheel.

2.5.3 Modern/Current Development

Onuzuike (2004) has stated that the modern potter's wheels are not much different from the old (18 century) potter's wheels. He mentioned that two main types exist, often differentiated by the source of power, the kick wheel and the power or electric wheel. He stated that kick wheel is rotated by foot power. Onuzulike (2004) stated that the modem potter's wheel driven by foot consists of vertical iron spindle with a small disk mounted on the top end (the wheel head).

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The disk is usually made of iron, but sometimes of wood or plastic. On the lower the lower part of the spindle is a large, heavy fly wheel made of wood or iron. The fly wheel provides the momentum and the potter keeps it in motion by kicking forward to the left. The spindle rotates in two sockets; one operates under the wheel head, screwed to wooden table. The other is fixed to

the ground and the lower end of the spindle fits into it (Rada, 1964). Seat has been attached to this type of potter's wheel. In addition to Rada's description of the wheel, this type of wheel is relatively cheaper and is simple for the learners especially as beginners (students of colleges of Education) should start with this type of wheel. It can interest the students to retain the practice after their course is ended in the colleges to continue with the profession.

The electric or the power wheels as stated by Onuzulike (2004), eliminates the use of manual power to drive the wheel head. Instead, an electric motor is used to either drive the wheel head or flywheel directly, or the shaft, which turns the wheel head. The speed is controlled through a hand or foot lever. From the era of the recorded history up to the modern times, throwing on all types of the potter's wheels has remained central to the work of artist potters all over the world.

The Colleges of Education selected for the study are established on their permanent sites. As such these types of equipment are necessary for the teachers to demonstrate their lessons and for the students to learn to handle them too. As the students come in year in year out therefore, the Colleges of Education should purchase such equipment or their equivalents and should maintained them for effective teaching and learning processes.

2.5.4 Glaze-Room Equipment

This is the equipment used for handling glaze purposes in the glaze-room or store or glaze-store. According to Nelson (1966) the wire whisk is usually sufficient for simple mixing of finely grounded commercial chemicals. He also pointed that mortar and pestle, a portable kitchen food mixer and paint mixer could be equipment used for simple mixing of glazes. That ball mill for larger amounts. He also made mention of brass sieves in mesh sizes of 80, 60,30,15, and 8, filters, gram scales, large powered scales, decorating wheels, dipping tongs and spraying tools is are the glaze-room equipment.

Norton (1956) observed that the equipment could be obtained through suppliers. The lecturers concerned in the Colleges of Education should decide the types of equipment to be supplied to them because they know precisely the types they need or prefer for better teaching and learning processes.

Nearly all the equipment stated by the authors are necessary for the programme of ceramic teaching in the Colleges of Education for effective teaching and learning processes and for better results. The equipment should be evaluated from time to time as Ewule (2004) suggested. The equipment stated by Alasa (2005) Norton (1956), Nelson (1978) and Hogan (1973) need to be supplied to the Colleges of Education in Northern-East Geo-Political zone of Nigeria for the effective teaching and learning process.

2.5.5 Kilns

Kilns determine the potter's effort, without it the potter's products are incomplete and almost useless. According to Frank and Janet (2002) kiln is a furnace for firing ceramic products. Alasa (2005) defined a kiln as a chamber made up of refractory and insulating materials, which accumulate and retain the heat directed into it. There are basically two types of kiln namely: the continuous kiln and the intermittent kiln. The heat produced in the kiln help in fusing the various clay materials and makes the ware hard, dense, rock like and permanent.

Hogan (1973) pointed that all kilns are made up of heat-resistant materials which will withstand the high temperatures to which clay is fired. Kiln confine and concentrate heat to the firing chamber, and allow for a gradual heat loss during cooling. She mentioned that specific kiln designs vary and that they are generally typed in three ways:

(1) By whether they are electric or fuel burning (also the type of fuel used) (2) By the temperature range they can achieve. Low fire kiln fires up to about 2300°F (cone 8,). High-firing kilns can reach about 2500°F (Conb 14,); and (3) By their size.

Gukas and Datiri (2001) noted that history of kilns dates back as long as the beginning of pottery (8000BC or even earlier). That the type of kilns could be imagined than proved at that period. They stated that kilns are perhaps the most important equipment of the potter. They also noted that kilns are refractory heat conserving chambers where wares are fired and that without it the art of pottery can never be complete. Kilns are structures built to conserve heat for firing ceramic products. According to Nelson (1966) thousand of years ago, man fired his pottery in a shallow pit on a bed of twigs and used broken shards to cover the heaps of pottery, to provide protection from the fuel above and to retain the heat. He suggested that a pit firing is an interesting project for a summer-camp ceramic class and that clay bricks with straw binders were used to construct a circular kiln chamber, a combustion area, a fire grate and an area pit. Nelson (1966) added that, technologically, a kiln was developed that had a permanent dome-shaped roof, a short chimney and a door opening from the side (To control conditions of oxidation and reduction to achieve red and black-figure ware in the kiln). Also that Chinese and Koreans higher-fire stone ware and porcelain were achieved because of their kiln design as their use of Kaolin clay bodies. He further stated that wood kilns are efficient at high temperatures; their use is however, declining because of the cost of fuel and excess smoke they produce.

Hogan also stated that kilns can be purchased or built and that many potters prefer to build their own to save money or to get a kiln a particular design and that plans for building kilns are available from books, craft magazines and stores. Also materials can be purchased from ceramic dealers, building and brick suppliers and sheet metal suppliers.

2.5.6 Fuel Kilns

Hogan (1973) stated that fuel kiln requires a chimney although it can be dismantled, and are generally considered permanent installations. That heat is not as evenly distributed as in electric ones. The great attraction of fuel-burning kilns is that both oxidation and reduction can be achieved in the same unit. She stated that an oxidizing atmosphere is one which an ample supply of oxygen is present to combine with carbon to form carbon dioxide and that if this oxygen supply is reduced, the carbon will turn to oxygen in the metallic oxides in the clay and the glaze and will effect a change in their colour, usually making the clay warmer and earthier in appearance and the glazes richer and more varied in texture. Any free carbon may settle in the ware, changing the clay colour to shades of grey or black (Hogan, (Ibid)). Hogan (Ibid), continued that, in a reduction atmosphere, special reduction glazes will change colour completely - iron in low percentages changes to grey greens, in higher concentrations to dark rust browns or black; copper changes to shades of red and pink. She stated that reduction firings begin and end in oxidation and that generally, reduction is done heavy at about cone 8 for about half (½) hour and gradually brought up to a moderate reduction for the remainder of the firing cycle. Also as she stated that oxidation takes place for the last 5 minutes so as to clear the kiln. These types of kilns though costly should be built for the Colleges of Education for the teaching and learning process.

According to Nelson whether wood, coal, oil, or gas is used as a fuel, the basic kiln design is much the same. A combustion area is needed either below or to one side of the kiln chamber. Wood or coal requires a larger area equipped with a grate and an ash pit. Saggers, which protect the glazed ware from flying ash, take up much space. In time, small kiln were constructed with an inner muffle chamber that served the same purpose. Both fuel oil and manufactured gas contain sulphur, which is injurious to lead glazes. The up draft muffle kiln was designed to eliminate this problem. The design however, creates extra heat in the floor area,

make an even firing difficult. Placing burners closer to the sidewall will alleviate the problem to some extent (Nelson, 1966).

The down draft kiln provides a more even heat distribution and has come to be the standard design used by most potters. This is especially true since the advent of cleaner natural gas, which has eliminated the need for a muffle. In down draft kiln the heat enter from multiple burners on each side, is deflected upward by the bag wall, and then is drawn down through ware to a channel under the floor by the section of the chimney. If the fuel supply and draft are adequate, adjustments to the bag wall height and damper can ensure a heat deviation of not more than one cone, and usually less, from top bottom to form a smaller-size kiln, with the burners placed to one side, may prove equally satisfactory.

A kiln that is fired with fuel oil requires a slightly larger combustion area than one using natural gas. Except for the arch construction, the design is similar to that of a gas kiln. The curve is established by suspending a chain from two points, thus forming a natural, self-supporting arch. A proportion in the base equals the height is the most stable and provides excellent heat distribution. Because the arch is self-supporting, no tie rods or steel frames are needed. Oil is a satisfactory fuel, cheaper than gas, but it has some drawbacks. A separate shed-like insulation is desirable, since the fume that is given off, together with the noisy blowers, make an oil-burning kiln impractical for use in the studio or classroom. Square kilns are more likely to fire evenly, and slightly wider door width is preferable to a deep chamber for loading convenience. It is assumed that the chambers of the kilns discussed have a loading area of about 10-20 cubic feet. However, many schools need a large capacity kilns and it is equally in order to have varieties for the sake of leaching and to make some necessary corrections where applicable in the Colleges for effective teaching and learning.

2.5.7 Electric/Gas Kilns

According to Hogan (1973) electric kilns are easy to operate, save, clean firing and run on household current and that they are relatively portable and can be transported. That heating evenly distributed and is fairly predictable and also not very costly. It also fires in oxidation and many glazes and decorative effects are geared to an oxidizing atmosphere. She observed that major disadvantages of electric kilns are that reduction atmosphere is difficult to obtain without badly damaging the elements. Thus wares may lack the richness of colour and surface interest of pieces fired in reduction, though most low-fire glazes do give a lustrous and gloss appearance. Also while the kiln itself will last indefinitely, the kiln elements will have to be replaced. Colleges of Education should be provided with various types of electric kilns for better teaching and learning processes, since they are easier to operate as Hogan (Ibid) stated.

As Ewule 1989 stated that the demand for industrialization is highly in the country, the necessity for better a kiln which would fire evenly and more economical is an asset. The construction of a gas kiln and suitable burner from locally available raw materials will no doubt help the students, teachers and studio potters build confidence in themselves.

According to Nelson (Ibid) the gas kiln, because of its cheaper operation, greater S2£SPid dbi!ity t0 Fcd'uCc, i5 pFcfeiTed by must studio potters and university ceramics department in the United States prefer the gas kiln. In the Scandinavian countries, however, where electricity is cheap and gas is not common. The electric kiln is almost universally used by the studio potter almctst all their universities use the electric kiln. The electric kilns have many advantages for the public school. It is as simple to operate as turning on a light switch, and there are no problems of burner adjustment or draft control.

There are three types of electric heating elements, suitable for a low fire (up to 2000T) is those made of coiled nickel-nichrome wire. The kanhol type is constructed of a different alloy and will produce temperature (up to 2300°F) cone 8, although some types will go higher. Larger higher firing industrial kilns use carbon compound in the form of a rod from one quarter ('/4) inch to 2 inches in diameter. Unfortunately, the special transformers needed are more expensive than the kiln itself, which places this kiln at a price disadvantage compared with the more inexpensive gas or kilns (Nelson, 1966).

Electric kilns are suitable for the countries where electric supplies are cheaper and constant or regular. They are not suitable for the countries where there is shortage of electricity such as Nigeria. However, the electric kiln is recommended for Colleges of Education for different reasons such as the cheaper operation and variety of sizes.

As pointed by Bayer (2007), anyone contemplating buying an electric kiln for the first time needs basic information. You need a suitable electricity supply, kiln, furniture and programmer/ temperature controller.

2.5.8 Kiln Furniture

According Hogan (Ibid) kiln furniture are refractory shelves and posts that vary in shapes, sizes and thickness. That hard bricks can be used for self supports and can be cut to sizes. She continued that top surface of all shelves are to be coated of kiln wash to prevent running glazes from fusing to pots on the shelf (kiln wash). She also mentioned that stilt or props are used to support shelves in the kiln, there are fire bricks and insulating bricks, Nichrom wire to prevent sticking.

Similarly, Nelson (Ibid) stated that kiln furniture includes the shelves, posts and other props used in the kiln. He suggested that three quarter *(^A)* inch thickness is adequate for

standard loads and that a center post is necessary to avoid sagging and possible breakage in span of 24 inches or more. He continued to suggest that rectangular shelves give longer service than square ones because they are less subject to stain in cooling and heating. He added that a slow cooling minimizes danger to the pots and prolong the life span of the furniture, especially the shelves.

2.5.9 Pyrometric Cones

Nelson (Ibid) pointed that Pyrometric Cones provide the potter with his most accurate method of measuring the work heat in the kiln. That it is tetrahedron or pyramid shape one and three quarter (l^3/^) inches high with a base that is one half('/2) inch across. He also stated that they are compound of materials similar to glaze. When softened by the heat they bend and when a complete arc is formed the temperature in the kiln is that of the cone number. Hogan (Ibid) stated that pyrometric cones are thin pyramids of ceramic materials that will not only deform or bend at a particular time-temperature but rather as a measure of the work done by heat on the pieces being fired.

Counts (1974) explained that pyrometric cones are shaped like slender pyramids and made of special combinations of clay that melt at known temperatures. Each cone is stamped with a number. The number on the cone indicates the temperature at which that cone will become soft and begin to bend at the tip. As the temperature rises, the cone bends and eventually melts completely.

2.5.10 Keeping a Log

One can get a special notebook for the purpose of keeping a log or record each time firing is done. Note the date, firing time, the weather conditions, the kind ware that was fired and the results.

2.6 Clay: The Ceramic Basic Material

Norton (1956) stated that clay is the backbone of the ceramic arts and that it has excellent workability when it is mixed with water. He further stated that clay is made up of tiny crystals that they cannot be seen under the highest power of an ordinary microscope. Green (1963) described clay as the end product of destroyed feldspar that the earth uses to contain through chemical action in form of acid bearing rain (weathering). He also noted that clay formed by this action usually lies near or on top of the granite and are known as kaolin. Olorukooba (1991) stated that the medium clay is one of the oldest art materials used by man. Norton (1965) stated that clays are found nearly everywhere on the earth's habitable surface. Basically, clay is composed of alumina, silica, and chemically combined water. Its molecular composition is Al203.2Si02. 2HzO in its purest state, but, in reality, clay also contains iron and other impurities that affect clay's colour and lower its melting point. Clay falls into one of two broad categories: residual or primary clays and sedimentary or secondary clays. The most common forms of clay are kaolin, ball clays, fire clays, stoneware clays, earthenware, porcelain, and so on. Aluwong(1989) stated that clay materials abound at most construction localities.

Singer and Singer (1971) referred to the term "Clay" as applied to those natural earthy deposits which posses the singular property of plasticity. According to Hogan (1973) clay is the result of the decomposition or erosion of the earth's rocky crust into minute particles of varying size. Counts (1974) defined clay as the end result of a long geological process. Alasa (2005) defined clay as the product of geological weathering of the earth's surface. Stephen (2005) defined clay that is made up of tiny crystals, which cannot be seen with naked eyes. It is the oldest ceramic raw materials and is among the most plentiful earth material to be found anywhere. Gukas and Datiri (2001) define clay as an earthy malleable substance. According to

Nelson (1978), Clay is defined as the very common but unique materials that make ceramics possible.

Olorukooba (1991) stated that the medium clay is one of the oldest art materials used by man. It has been shaped into the most primitive utensils (cups, mugs, pots, etc.)

clay serves as an essential ingredient in the production of electronic and electrical components. He continued that the possible reasons for the universal practice of this art could be due to the availability of clay in all parts of the world. Clay does not need an elaborate preparation. Kparevzua (2004) observed that clay is a traditional medium in constructing buildings and producing various items common to societies all over the world. That it is valuable for producing hand crafted forms like bricks, kitchen-wares, household decorations, toys and so on.

Clay is a material which is cheap, widely available and by comparison with stone relatively light, (http:/www.historyworldnet/w^dhis/plaintexthistories.asp'?histo^y:2006)

2.6.1 Source of Clay

According to Aluwong (1989), clay materials abound at most construction localities. The garden clay pits and construction sites may yield us variety of clay materials. Some knowledge of the local geology or consultation with geology teachers, also local potters can be sources of valuable information. Ball clays are usually more plastic and have greater shrinkage. These clays can range in colour anywhere from a light tan to a dark reddish-brown after firings.

Norton (1965) stated that clays are found nearly everywhere on the earth's habitable surface. He continued that clay is a secondary product in the earth's crust; it resulted from decomposition by weathering of the older rocks of the feldspar type. Counts (1974) stated that we get clay when a granite-type rock is broken down and decomposed into fine particles. When water is added to these particles, they become plastic and can be forced into shapes. Nelson

(1978) observed that clay is derived from the disintegration of granite and other feldspastic rock which, as they decompose, deposit alumina and silica particles. Gukas and Datiri (2001) noted that clay is formed as a result of the decomposition of an igneous rock. That clays vary according to their location, that is where the clay is found in site (place of formation), or it is a resettled clay They continued that primary clays are residual clays and secondary clays are clays that have been transported from their places of formation by such natural forces as wind glacier and water, and have been further deposited in strata in lower areas.

Opoku (2004) noted that clay occurs naturally almost everywhere in the world and is formed by the action of weathering on several kinds of rocks. Horgan (1973) stated that granite-type feldspatic rocks are the source of all clays. Alasa (2005) explained that clay is the product of the geological disintegration of feldspatic, pegmatic and granite type of rock which agents of disintegration include rain, running water ice or glacier, wind, roots of plants, animals, carbon-dioxide and extreme differences in temperature. That clay is composed of microscopically fine particles He also stated that pure clay contains alumina (A^Oa) Silica (SiOz) and water (HzO). Basically, clay is composed of alumina, silica, and chemically combined water. Its molecular composition is Al20:i.2Si02. 2HzO in its purest state, but, in reality, clay also contains iron and other impurities that affect clay's colour and lower its melting point. Mode and Amobi (2006) stated that they (clays) all originated from process of instability in other silicate minerals. The genesis of clay involves the dissolution of a given mineral or group of minerals, which produces a solution of a different aggregate solute composition from that of each of the reacting solids. The four geological processes that result to clay mineral formation are water-rock ratio, rock composition and temperature at which the reaction takes place.

Clay falls into one of two broad categories: residual or primary clays and sedimentary or secondary clays. Those clays which stay close to the site where they were formed (the "parent

rock") are called residual or primary clays, for example Kaolin or China clay. Relatively unaffected by the elements, they are coarse particle size and are not very plastic. They are more or less free of impurities, retaining a whiteness of colour and a high resistance to heat. Primary clays are usually blended with other materials to make it more workable. High firing porcelain clay bodies include primary clays in their composition.

Other clays are moved from their origin, usually by water, also by wind or even glacial action. When they finally come to rest, these sedimentary or secondary clays are finely grained because of the grinding action of moving rivers and streams on the clay particles and because heavier particles have already settled out at earlier states of the journey. Therefore, they are more plastic than primary clays. Sedimentary clays have undergone change on their journey, mixing with other materials as they are transported.

According to Manzuche (2003) clay is characterized as soft, plain, and plastic. It can be bent, molded, pounded, pinched, flattened, rolled coiled, thrown on a wheel, and cast into mold to produce functional and esthetic objects. It responds to shape, bending smoothing, drying, glazing and firing.

Owing to these fundamental characteristics, clay has been singled out to be the most important element in the whole world, which serves as a means of technological development ever since the early man in the eras of man's creation. The clay which is available all over the world is the principal material for pottery making. In this regard clay should be made available for the students of college of education in the North-East Geo-political zone of Nigeria for better practice of teaching and learning process gearing toward perfection in the profession. Different type of oxides should also be made available for constant practice of glazes.

2.6.2 Types of Clay

As Norton (1965) noted. Kaolin, Ball clays. Stone Ware clays, and Red Bricks clays are the ones of chief interest to the potter. Hogan (1973), Nelson (1978), Gukas and Datiri (2001) and Alasa (2005) are of similar view on the clay types stated. Gukas and Datiri(2001) added, Bentonite, High Alumina clays. Terracotta clay, Flint clay. Gumbo clay and Shale as other clay types. All these clays have their functions. Some of them are low fired (temperature) and some are high fired (temperature). An example of low fired clay is the earthenware clay. An example of the high temperature clay is Kaolin. Their colours vary according to their origin and their types. They are used in proportions in productions and in glaze formations.

Clay which is the main material for ceramic teaching should be made available, in their varieties, for the teaching of ceramic in the Colleges of Education so that students will understand the better usage and the characteristics of the clays. They should be encouraged to experiment with some of the clays within their various localities and this could be easily done through the local potters. Usually clays are named after the localities they are obtained.

Alasa (2005) stated that most primary clays lack plasticity and to improve the clay plasticity or workability plastic clay materials such as ball clay and or bentonite is usually added to the clay. That it can withstand a temperature of about 1750°C. Primary clays abound every where in Nigeria. In his locality, it is located at Iggara in Akoko Edo local government area and Afowa in Etsako West local Government Area of'hcio state. He also stated that other clay types are also found in places like Afowa, Ugbenor, Agbede, Jagbe etc all in Etsako West Local government Area of Edo state.

Kaolin: **-** A very pure, natural clay and white in colour, is never used by itself because of its relative lack of plasticity and its resistance to heat except at very high temperatures. Kaolin is important ingredients in the formulation of whitewater bodies.

Ball clays:- Are relatively pure (although not as pure as Kaolin), high firing (to about 2400"F) natural clays which fire close to white in colour. They are fine-grained and plastic but are not used alone because of their high shrinkage rates. Ball clays are often added to i;lay bodies that contain Kaolin to render them more plastic and workable.

Fireclays: - Can be either plastic or coarse and unworkable. Their characteristics vary except that all fire clays are extremely refractory or high firing (to about 2700'T) and are used to make firebricks, to line kilns and fireplaces, and for kiln shelves and posts. The presence of some iron in fireclays imparts a cream to tan colour to the fired clay.

Stoneware clays: - Very popular with potters, vary in their plasticity and in drying and firing characteristics. They can be used alone if these characteristics combine into a workable material. More often, stoneware is a blend of natural clays, plus other ingredients added to obtain a desired degree of plasticity, colour, and maturing temperature. These clays are high firing, maturing between about 2200 and 2300°F, and range from light tans to darker browns and grey when fired. Because they become hard and vitrified when fired, they do not need to be glazed to hold water.

Eathenware : - Is either a single natural clay or a mixture of several clays that fires to a relatively low temperature (1700 to 2100°F) because of impurities (fluxes) that lower its melting point. The fired body is only partially vitrified and therefore remains porous, is subject to chipping and will not hold water without being glazed. Fired earthenware ranges in colour from white to buff and light tans, pinks, reds, and browns.

Porcelain: - Is compounded clay composed of white burning clays, Kaolin, and ball clay, along with fluxes and silica. Porcelain is a very high firing clay (between 2500 and 2700°F). When fired it becomes white, translucent, very hard, and vitreous. Its low plasticity makes porcelain

difficult to work with. Hogan (1973); Nelson (1978) Gukas andDatiri (2001) and Alasa (2005) agree with this observation.

These varieties of clays should be adequately provided to the students in the Colleges of Education for practices and experiments. When the knowledge obtained in the colleges is being transferred properly and confidently to the younger students, they will be excited and eager to enroll into ceramics courses leading to better and qualitative products. Have access to the clays, would enable the students to mix different clay bodies and understand them gradually. Also understanding of the chemical aspects of the clays would be easier and faster for them and they could know which clays are suitable for particular purposes. A good knowledge about these by the students is essential since they are going to transfer such knowledge to the younger students in the secondary and primary schools.

According to Umar (2003) nearly all clays contain some impurities, that is why processing of clay before working is important.

2.7 Ceramic Raw Materials

In the midst of advanced technology, we can achieve almost any effect we wish with ceramic raw materials. But first we must know something about these materials and how to use them. A potter must have practical knowledge about the elements themselves -their characteristics, how they work with other elements, under what heat conditions they produce best results, and in what compounds they are readily available. He will then beable to devise glaze recipes intelligently (Count, 1973). According to Nelson (1978) in order to gain an understanding of the qualities imparted to the glaze, the beginner should make several tests with varying proportions of the ceramic materials. Emodah (2005) stated that the basic materials needed in glaze formulation are available all over Nigeria.

2.7.1 Glazes

A glaze is a thin, glass-like coating which changes the surface colour and texture of a pot. Norton (1956) defined glaze as a thin layer, or glass and crystals that adheres to the surface of the body. According to Nelson (1966), Glaze is a thin, glass-like coating that is fixed to the clay surface of a pot by the heat of the kiln. Hogan (1973) has the same view with Nelson (1966) based on his statement that glaze is a glassy coating which fases to the surface of the clay in the presence of heat. There are three main or basic elements required in glaze formation:

1. *Silica,* the glass former, (2) *A flux.* which lower the fusion point of the silica; and (3) *Alumina,* a refractory element that gives added toughness and hardness to the glaze, allows a higher maturing temperature, increase viscosity and prevents diversification.

There are different types of glazes, for example ash glaze, Temmoku, Chun, Crakle, Raku and others. Ach batch of glaze is being prepared or formulated depending on the products the potter is going to glaze. The firing temperature will also determine the type of glaze to be formulated. The formulation of glazes also should note the availability of the materials at hand. For example, low fire glaze materials could be varying proportions of feldspar. Kaolin and Borax fired to cone 04. A suggested beginning formula for a cone 04 glaze test is three parts borax, three parts feldspar, and four parts Kaolin. A total sample of 100 grams is advisable. Experience is required in glaze formulations (Nelson, 1966). The glaze should be tested on tiles before applying on large products to avoid materials and time wastage.

Hogan (1973) stated that glaze formulas are available in books and craft magazine and from the potters. Raw materials for glaze formulation are quite in-expensive and easily available from ceramic supply stores. You will need containers for storing glazes, measuring cups and spoons, a 60-mesh screen, a brush for applying the glaze, and an under glaze pencil for making

test tiles. You will need a balance scale for very accurate ingredient measurement. The colleges should have these facilities in their stores.

To mix glaze, use enough water in proportion to the dry ingredients so that the result is about the consistency of light cream: pour the glaze through a screen to remove lumps. Transfer the glaze to a labeled container when it is ready. Only by experimentation will you gain an understanding of the interrelationship of glaze materials, the particular effects of each ingredient and how to adjust glaze formulas to fit a clay body.

2.7.2 Glaze Raw Materials

Glaze raw materials are the solid minerals that are milled and mixed to form giaze. Common materials that are used in glaze include the following: Calcium oxide -CaO, Zinc oxide - ZnO, Barium oxide - BaO, Kaolin chain (Al^2, Al_2O_3 (OH_4), Feldspar potash- K_2O, Al_2 O_3 6 Si, O_2, and so forth. Glazes are important factors in ceramic materials. Its application to pottery products dignifies the products It also allows the products to be fired at high temperature, which guarantees the hygienic aspect of the products.

You may prepare your glaze depending on the availability of materials and the type of product you intend to produce and the purposes of the products.

2.7.3 Glaze Formation

Nelson (1978) stated that glaze can be made from only three necessary elements: Silica, the glass former, a flux or glass, and alumina, the refractory element. He advised that it is not economically practical to use refined and pure oxides to make up glazes. That the compounds employed by the potter are usually those mineral that are abundant in nature in a relatively pure state. He added that lower fire glaze will consist of Kaolin (A1203. 2Si02. 2H20) potash and feldspar (K_2O. Al_2O_3. $6SiO_2$) and red lead (pb_3 O_4} or borax ($Na_2O.2B_2O_3$. lOHzO) as the flux. He continued that in order to gain an understanding of the qualities imparted to the glaze by silica, alumina and the flux, the beginner should make several tests with varying proportions of feldspar, kaolin and gerstley borate fired to cone 04.

Gukas and Datiri (2001) stated that glaze making requires precisions even though many materials are involved. That a lot of variables must be taken into account before good results can be achieved and that the art of glaze formulation is an art with definite procedures, using the right material. They suggested some metallic oxides as sources of colours in glazes. These

include iron oxide (FezO^), Cobalt oxide (CoO), Chromium oxide (Cr203); Copper oxide (CuO) manganese oxide and Nickel oxide. Alasa (2005) stated that there are about twenty-one (21) materials, which are commonly used in glaze composition. Some of the materials used in ceramics glazes and bodies include: Flint (SiO;), Clay (AlzO.-, 2SiC>2. 2H20), Feldspar (^OAlO; 6 Si02), Whiting (CaCO.^, Zinc oxide (Zo) and Tin oxide (SnO^). Others include Talc (3Mg04Si02 H^O), Borax (NaO ZBiO.ilOl^O), White lead (2PbCC»3pb) (OH2); Red lead (Pb.-^) and so on.

Alasa (2005) stated that most of the commonly used glaze materials are derived from common rocks and minerals that are quite abundant and cheap. He also stated that most of the high firing glazes are compounded from feldspar, flint, limestone and clay and that the three basic ingredients used in compounding base glaze are flint, feldspar and clay. Alasa (2o05) continued that it is from the glaze raw materials that important oxides employed in glaze composition are obtained. He cited an example of whiting (CaCo) yielding only one oxide in the finished glaze, which is calcium oxide (CaO). Other materials such as clay, corn wall stone, talc, colemarite and so on can yield several oxides,

Alasa (2005) again stated that most glaze materials are supplied from the BW^Hrss in form of finely grounded powder. That glaze materials are usually attached with a supply label for easy identification and to avoid mistaken identification since most glaze materials look alike. Also some glaze materials are toxic, such as lead compound and barium. Alasa (2005) advised that the raw materials used in glaze should be insoluble in water. That some eventually turned out to be soluble and caustic, with such materials extreme care should be taken to avoid prolong contact with the skin. According to Garkida (2004) the presence of powdered glass in a glaze batch will hasten the formation of the glassy state.

2.7.4 Glaze Type

According to Alasa (2005) the Egyptian has the earliest glaze, dating back to 3,OOOBC, or earlier. That the discovery of the application of glazes on pottery ware in Egypt resulted accidentally from the melting of potash and sand deposits under bon fire. The glaze is named after the place it has been formed, that is Egyptian glaze.

Salt Glaze, according to Alasa (2005) is composed from the common salt sodium chloride). There are also slip Glaze, Ash glaze, low melting glaze, the lead glaze and so on. Glaze composition should be taught to the students of Colleges of Education early enough so that they can gain the necessary experiences before they graduate. The glaze types should be made readily available in the stores for demonstration and practice in the colleges of education. The lecturers concerned should strongly advise the student on how to handle the glazes because some are toxic as stated by Alasa (2005).

Gonah *et. al.* (2003) stated that glazes are virtually ground glasses, being based upon mixtures of silica and fluxes, the nature of which depends on a number of factors but which allows the glaze to melt at a certain temperature range from 950°C and above At all lower part of the range, the glaze normally contains manufactured fluxes. It is I known as frits which will be either without lead or will contain lead, although in the later event the lead content must be chemically combined with frit usually in the form of a lead event the lead content must be chemically comomed with rrn usUally iH (Kit; t8rrH 8t a leaf3 bisilicate or lead sequisilicate.

Pottery glazes are made to melt but to be static on the surface of the wares unto which they are applied, even when fired and have fused. Pottery glazes are glass in themselves (alumina). Alumina introduced to a glass batch increases viscosity making it suitable for glazing ceramic wares. Glazing is the best form of ceramic decoration (Datiri and Gukas, 2001).

Glaze materials are ground finely in a ball mill and sieved very fine slurry of 40-80 meshes. In advanced ceramic we shall be able to see that surface protection of ceramic goes beyond decoration and include sol-gel, nitride ceramics, and composites etc. which are used purely to get a particular type of effect. This is the application of sol-gel to ceramic surface or the deposition of sol-gel to ceramic surface or the deposition of powder on surface known as chemical vapor deposition (CVD) (Emodan, 2006). Although this procedure may appear too advanced for students of Colleges of Education, if the materials are made available, it could be advantageous to try their hands on them.

In sum the basic materials needed in glaze formulation are silica, feldspar, limestone, flint and so forth. These materials are available all over Nigeria. There are different types of glazes made from special materials for special purposes. The electric porcelain glazes for example are designed for their high temperature application for use in electricity insulation.

2.7.5 Ceramic Oxides

Oxides are formed when oxygen combines with an element, metallic or non-metallic (Cotton and Wilkinson, 1980, Menham, 2000). Glaze components according to Wheeler *el al* (1973) are not single refined oxides but complex compounds that are -"•'TwrciaUy available at reasonable costs. The oxides may act as a base, neutral or acidic oxide serving as fluxes or colorants. Fournier (1973) asserted that each oxide used in pottery is discussed under the entry for each element. Hogan (1973) noted that metallic oxides and stains are used to give colours to the clay body or glazes and can be used under or over a glaze and that oxides commonly used as colorant are cabalt. The basic oxides for glazes include:

1. *Zirconium silicate* - This gives the desired opacity and some how whiteness to the glaze (Alasa, 2005). It is a strong opacifying material when used in glazes having a high content of

alumina and silica but low in alkalis. It produces a strong white except when used in glazes to give a cream tint. It also controls crazing, texture and stability of colour (8-10%). Generally used in conjunction with zircon fritt, it is not a direct substitute for tin oxide, but it can be an effective replacement in a suitable glaze (Fulham Pottery, 1671, Wheeler *clal*, 1973).

2. *Colouring oxides* - These are raw pigments from which prepared colours and stains are compounded. Hov/ever, they can be used alone in the usual colouring applications in bodes and in under and on glazes (Fulham Pottery, 1671).

3. *Feldspar* - Feldspars are universal fluxes used in all types of bodies. They affect all characteristics of the fired ware and are ever translucent. Feldspars combine all principal glaze ingredients in an insoluble form. Used in almost all glazes, particularly stoneware (up to 50%), those incorporating potash feldspars are more durable, those containing soda feldspar mature at a lower temperature (Fulham Pottery, 1671, Counts, 1973, Wheeler *el al*, 1973). According to Alasa (2005) glaze with high feldspar can craze following the presence of high sodium or potassium content. Singer and Singer (1971) describe feldspars as the most important flux used in ceramic body and glazes.

4 *Zinc oxide* - This is the only source of zinc for glazes. Zinc generally increases the maturing range of a glaze and promotes higher gloss, brighter colours, a reduction of expansion, and under some conditions, it is an opacifier (Wheeler *el al*, 1973, Count,

1973, Alasa, 2005). According to Fulham Pottery (1671) in small quantities zinc oxide performs as a flux, alleviates crazing problems and increases firing range. In larger (|uantities, it can be used to supplement opacifiers such as tin. Above 10% it develops a cool white crystalline matt surface.

5. ***Tin oxide*** - It is the most affective opacifier. A 5-7% addition to glaze ingredients «'\\\ produce a completely opaque white glass. Excess will produce a dull surface. It is also used

widely as a stain since it has a considerable colour effect on colour qualities of most colour forming oxides (Alasa, 2005). The Fulham Potter}' (1671) describes tin oxides as the most widely used and effective opacifying material giving the white colour typical of majolica and delftware. According to Wheeler *el al* (1973) tin also has a wide use in stains, since it has a considerable effect on the qualities of most colour forming oxides.

6. *Iron oxide* - Oxides of iron have a very wide application as pigments. In addition to the general effects of the individual oxides, most of them will give a variegated yellow/tan colour, depending on thickness, in a lead/tin glaze (Fulham Pottery, 1671).

7. *Lead oxide* - Lead monoxide is more inclined to reduction by firing. White lead dses readily and also helps to keep the glaze slip from setting. Red lead does not fuse readily as white lead and is not commonly used in glazes because of its coarse particle size and its tendency to settle out in a glaze slip (Alasa, 2005). Lead results in a smooth, brilliant glaze with few surface defects (Wheeler *et al,* 1973).

8. *Talc* - This is a fluxing material used in all types of glaze to produce typical magnesium effects. In large quantities it gives opacity and vellum texture. Having low expansion and contraction it can also cure crazing. Talc is also used to introduce magnesium and silica into bodies, particularly those fired at low temperatures (Wheeler *et al,* 1973, Fulham Pottery, 1671). According to Alasa (2005) it can be used as a flux in a glaze body especially in low firing bodies. Cardew (1971) refers to it as the chief mineral among the basic oxides.

9. ***Silica*** **-** It increases firing temperature and reduces plasticity and shrinkages. It may be-added in small quantities to prepared bodies to eliminate crazing. Its characteristics of low expansion and contraction stabilize the glaze and minimize any risk of crazing (Fulham Pottery, 1671, Alasa, 2005). It combines with heat at low temperature to form a glass and with alumina compounds to form the more refractory body structure (Wheeler *el* a/, 1973; Nelson, 1978).

10. *Bone ash* - Bone ash is sometimes used in glazes as a flux and as a body ingredient in bone china. It functions as an opacifier and as a source of calcium in glazes. It produces a delicate colour shade due to traces of certain colouring oxides (Alasa, 2005). Its use in large quantities reduces plasticity and workability, it is therefore more suitable for casting processes (Fulham Pottery, 1671). It lowers the firing temperatures required and increases translucency (Wheeler *el at,* 1973).

11. *Alumina* - Used primarily to promote stiffness of glazes (6-10% of silica content) increasing firing temperature and resistance to chemical attack In larger quantities *(ISVo* of glaze), it however, produces opaque and matt effects. It is also used dry on kiln shelves as protection against glaze sticking (Fulham Pottery, 1671). Alumina adds dryness and opacity to glaze; it also has better adhesive qualities and stays in the glaze longer (Counts, 1973; Wheeler *et a/,* 1973).

12. *Sodium oxide* - It is very active chemically and functions in glazes as a strong flux or melter. Sodium oxide is a valuable aid to the formation of possible silicates, but in excess it reduces the resistance to chemical and physical attack (Alasa, 2005, Counts, 1973).

13. *Soda ash* - It is used as a glaze and is a powerful flux which also produces an alkaline colour. When introduced into low solubility glazes it will weaken their resistance to acid attack (Fulham Pottery, 1671). It reduces the water of plasticity required in a clay body and this increases the workability and strength of the plastic body and reduces shrinkage when it goes from wet to dry stage (Wheeler *et al,* 1973).

14. *Wftifing* - Whiting is a major high fire flux. It has limited use in bodies where a small amount will lower vitrification temperature and reduce porosity. As a flux it produces harder and tougher silicate than either lead or alkaline compounds. Calcium like other fluxes has an effect on colouring oxides particularly chrome greens (Wheeler *et al,* 1973, Alasa, 2005). According to

Fulham Pottery (1671) whiting contributes to hardness and durability and in large quantities produces a matt effect. It can enhance the finish of salt glaze ware by developing a thicker glaze.

15. *Magnesium carbonate* - It is a flux in high temperature glazes (up to 10%). Excess produces a semi-matt surface and may lead to crawling and pin-holing. In low temperature glazes it reduces fluidity (Fulham Pottery, 1671). Alasa (2005) stated that it lends to mix more easily into the raw glaze than the grounded magnesite. Wheeler *et al* (1973) suggested that it is valuable to slow down the fluid qualities of crystalline and other runny glazes.

16. ***Boron calcife -*** When used as a principal flux, colemenite gives a broken molted texture, which can be quite attractive. It can also give a milky blue, opalescent duality to glaze. Lead and colemenite give a reliable low fire glaze (Alasa, 2005). It is [!:] used as a flux in all types of glazes, it also reduces crazing tendencies (Fulham Pottery, 1611).

\7. *Copper* ***oxide -*** It is a strong flux and its addition may make the glaze noticeably more fluid and bright in surface. Copper oxide influences the colours of other glazes in the kiln and it yields blue colours with alkaline glazes, while in lead glazes it produces various shade of green colour (Wheeler *el al*, 1973, Counts, 1973, Gukas and Datiri, 200). Fulham Pottery (1671) describes copper oxide as a black material which gives greens in lead glazes and with calcium and magnesium. At high temperature in oxidized ""ings, the colours tend to weaken, in reduction copper red is produced.

18. *Manganese oxide* - According to Gukas and Datiri (2001) manganese when compared to cobalt or copper will be regarded a weak colouring oxide. It produces a rich-blue plum colour in alkaline glazes and a softer purple in glazes. Wheeler *el al* (1973) stated that manganese oxide is used in ceramics as a colorant. The usual colours produced lie in the brown range but with cobalt, a black result, with the proper alkaline fluxes, purple and dark reddish hues can be produced.

19. *Nickel oxide* -Nickel oxide is a source of more subtle colours at stoneware temperatures (Counts, 1973). According to Wheeler *el al* (1973) the function of nickel in ablaze is almost solely as a colorant. In general nickel is used to soften and alter other colouring oxides and the use of 5-10% nickel in a proper glaze results in the formation of acrystalline structure l-'ulhain Pottery (1671) and Gukas and Datiri (2001) describe it as a colouring compound most often used to modify other colours.

1.8 Sources of Getting Ceramic Equipment and Materials

Some equipment could be made or bought at cheaper price by the students and teachers if required at any time in pottery making. Students need to initiate with the local potters where necessary. Since learning is a gradual process, making of the pieces of equipment would gradually be developed through practicing and experiences.

Ceramic equipment could be obtained through different ways. The potter could make arrangement for the construction through experts in such field. The porter could also contact companies direct for the purchase of equipment. The potter could also make arrangement to get the potter's wheels and other equipment by sending or posting money through appropriate channel(s), especially if it is going to be imported after the potter has town the price and the procedure of delivery.

Equipment such as potter's wheel (manual or electric wheel), pugmill, blungers and so on could be obtained directly from the manufacturers in this way (Norton, 1956). Magazines, journals, emails and Medias could be source of information to companies like stoke-on-Trent London and others (Price list June, 1989).

Ceramic tools could not be separated from ceramic equipment and materials. They are in the same house. The potter's hand which is the fundamental tools in pottery making is natural. Other locally made tools are import factors in ceramic establishment. Some examples of the locally made or improvised tools are, knifes, sieves, ribs, sponges, spatula, trimming tools, cutting wire and others.

Different types of clays are found in different localities across the nation. The clays are mostly named in the local languages in the areas they are located or found. For example the kaolin which is located in Kankara village in Kaduna State of Nigeria is called Kankara clay. The type of clay which is called Bomo clay is found in Bomo village of Zaria in Kaduna State

of Nigeria. Some of these types of clays could be obtained, locally in different places in the nation especially in the North Eastern part of Nigeria.

Glazes which are of high importance among ceramic materials could also be improvised or locally obtained in most part of the localities across the country. Examples of these materials or recipes for glaze making are clays, wood ash, oxides, feldspars, silica (sands), rice husks, quartz and others. Kilns can be imported or built by the experts . in the field for use. In the case of equipment that cannot be easily improvised, Norton (1956) suggested that they could be obtained through suppliers, as long as they could supply qualitative equipment. The equipment could be tested before completing the payment of the supplies. This is to encourage the suppliers to supply qualitative equipment to the colleges of education.

2.9 Care and Maintenance of Ceramic Equipment and Materials

To achieve the life span of ceramic equipment and materials care and maintenance has to be rendered accordingly. When the ceramic equipment and materials are being used they should be put back into order appropriately after their use. Services should be carried out on the equipment when required. The materials need to be kept correctly and stored in the appropriate place. The materials should also be labelled according to their names. This is to avoid accident to poison as suggested by Fulham (1(71) and Alasa (2005).

2.10 Managing the Material Resources

According to Akpa (2003) what constitutes the material resources of a school may include those supplementary inputs that support teaching and learning in the school, like llboratory equipment, workshop tools, library equipment, books and non-text materials iswell as media and teaching aids. These are hardly available in schools. Just as there are fflipty

classrooms without furniture, the laboratories are without reagents, the workshops irewithout tools and materials, and the libraries are without relevant books. Generally, looks are non-existent due to economic adversity or poor literacy habit or both. Teaching lids are left to teachers' initiative and resourcefulness. Whereas these resource help to strengthen teaching and learning by making learning particularly more concrete and real, Ites is eluding us in Nigeria due to the impoverish ness of the school. The management tffort ofthc school administration should concentrate on how they may be raised and sustained in the school. Prudent uses of these resources are the way to the success of the

2.11 Resources Maintenance

Akpa (2003) stated that the issues in the management of school resources in Nigeria draw particular attention to one of the nation's greatest problem: that of lack of maintenance culture. The fast deteriorating school infrastructure, declining finances and increasing enrolments, compel the school manager not only to be resourceful but to make prudent use of the little that is available. This is more so as it has not only become impossible to acquire any school equipment and facilities, it is increasingly difficult to replace the old ones. Therefore, rather than avoiding waste and guarding the available resources, a maintenance culture must be cultivated as a necessity, we must learn to apply routine and preventive maintenance. In addition to maintenance, initial acquisition must iswell be a factor in quality and durability considerations.

2.12 Summary and Uniqueness of the Chapter

The review of related literature which covered studies from developed and developing countries have shown that success of any ceramic education activity (teaching ind learning)

depends mostly on the quantity and quality of available facilities, equipment and materials to meet the needs of students as well as the teachers.

Hogan, (1973) stated that as a starter, the under listed standard equipment below will be set of implements that the starter (s) might use from the start to the finish of piece. These equipment are: Rolling pin, calipers; Brushes; Fettling Knife; Needle or pin; wire cutter; Ribs; scrapers; sponges; modeling tools. Bats, Banding Wheels, wedging table or board, pet lifters; rulers and others for effective teaching and learning of ceramic education in colleges.

Cardew (1970) made a blunt conclusion that "Nobody knows exactly when the potter's wheel was first invented. Nelson (1966) recommended the electric kilns for colleges for different reasons, such as the cheaper operation, greater in size and ability to reduce effectively. Alasa (2005) noted that clay is the product of geological weathering of the earth surface. Aluwong (1989) stated that clay materials abound at most construction localities Gonah *el al* (2003) stated Glazes are virtually ground glasses being based upon mixtures of silica and fluxes, the nature of which depend upon a number of factors but which allows the glaze to melt at a certain temperature range from 950^{o}C and above.

Akpa (2003) stated that the issues in the management of school resources in Nigeria draw particular attention to one of the nation's greatest problem: that of lack of maintenance culture. However, standard equipment should be provided to the Colleges of Education in the North East Geo-position zone of Nigeria for refortified teaching and learning in these colleges. This will give the students insight into understanding the equipment, their uses and maintenance procedures during their practical lessons. The equipment should be maintained form time to time.

When a Colleges of Education decide to buy their wheels, consideration of the prices, speeds, spaces, the sitting or standing position and the maintenance should be considered. They should not rush to purchase the wheels. They should endeavour to read literature and specification sheets available from manufactures and ceramic supply stores, take to other potters, and try out as many models as they can so as to avoid regrets. When buying for Colleges of Education, the number of students on ground should be considered to avoid shortage of wheel for the students.

According to Nelson (1966) good potter's wheel are rather expensive. Experts can throw on any type of wheel while a beginner will have difficulty achieving satisfactory results on poor equipment. Nelson (1966) also suggested that poorly constructed wheels should be avoided for schools and colleges and he concluded "Better hand-built pottery than to settle for inferior wheels to schools".

Agreeing positively with Nelsons (1966) suggestion the Colleges of Education should purchase qualitative wheels that will last for longer period of time. By so doing, they will not demand frequent repairs and maintenance from the College authorities. Also if they are not of good quality, purchased wheels spoiled within short period of time. This tan distract or affect the teaching and learning processes. Thus durable simple kick wheels for may be more appropriate for beginners. A wheel with an integral and adjustable seat, a splash pan and foot rests is undoubtedly the most convenient. A few of these have motorized attachments.

The Colleges of Education are established on their permanent sites, as such these types of ceramic equipment are necessary for the teachers to demonstrate their lessons aid for the students to learn to handle them too. As students come in year in year out, the Colleges are should buy

such equipment or its equivalent and maintain them as well. In the same view with Nelson as stated above Glaze Room equipment are required in good ceramic workshops

This chapter reviewed literature on the facilities, equipment and materials for ceramics. It also discussed issues on the management of ceramic resources in the Colleges. It also covered care and maintenance of the ceramic equipment and facilities and how to obtain them for effective teaching of ceramics in the Colleges of Education in the North-East Geo-political zone of Nigeria.

CHAPTER THREE

Methodology

Introduction

This chapter dealt with the method that was used in undertaking this study. The study was designed to evaluate facilities, equipment and materials for the effective teaching of ceramics in some selected Colleges of Education in the North-East Geopolitical zone of Nigeria. This chapter is discussed under the following sub-headings.

- Research design
- Population, sample and sampling procedure
- Research instruments
- Validation and reliability of the research instruments
- Method of data collection
- Procedure for data analysis

3.1 Research Design

According to Kerlinger (1977) "research design is a plan, structure and strategy of investigation conceived to obtain answers to research questions and to control variance". The design adopted for this study is the ex-post facto research design This design focuses on gathering information on situations, facts, phenomenon and events that have occurred or are occurring so as to ascertain the present trend. The descriptive survey method was adopted for use in the study. This method is most adequate for determining the present situation of things and uses observation, interview, questionnaire and checklist for gathering data to describe current trends. The questionnaire was however, the main instrument for the study.

3.2 Population, Sample and Sampling Procedure

There are seven Colleges of Education in the North-East Geo-Political zone that offer ceramics as a programme in their Department of Fine and Applied Arts. Four Colleges were randomly selected for the study using the ballot method. The sample frame for the study with regards to the students from the Colleges of Education is 147. The sample size of the respondents from each of the Colleges of Education was twenty (20) students. The randomly selected students from the four Colleges made a total of eighty (80) students who served as respondents for the study.

The researcher administered the questionnaires to the students with the assistance of the lecturers and these were collected back immediately. The checklist was used for direct observation of facilities, equipment and materials in the four Colleges of Education sampled for the study. i,3

3.3 Research Instruments

The instruments for the study were questionnaire and checklist. The questionnaire consisted of thirty (30) questions on the availability, adequacy and functionality of facilities, equipment and materials for teaching ceramics to students. The checklist contained the basic facilities, equipment and materials required for the effective teaching of ceramic education. The questionnaire was based on the Likert type of scale. The scoring system was as follows:

Scoring system	Marks
Strongly agreed	5
Agree	4
Undecided	3

Disagreed	2
Strongly disagree	1

3.4 Validity and Reliability of the Research Instruments

The research instrument was designed by the researcher with necessary corrections made by the research supervisors. The questionnaire and checklist were vetted by four professionals in the field of research from the Faculties of Education and Environmental design including Professor F. D. Kolo, Dean Faculty of Education ABU, Zaria. The instruments were found to be valid for the study.

The research instruments were then used to conduct a pilot study at the Federal College of Education, Gombe to test the reliability of the instrument. A total of twenty (20) students served as respondents from the department of Fine and Applied Arts in the study. An interval of four weeks was then given, after which the questionnaire was administered on the same subjects and collected. The Pearson Product Moment Correlation Coefficient (PPMCC) was then computed and the obtain value (r) was 0.96. This shows that the instrument was reliable. FIowever, the respondents who took part in the pilot study did not take part in the actual study.

3.5 Method of Data Collection and Procedure

The questionnaire was self administered by the researcher with the assistance of the lecturers to the respondents after introductions had been made. A total of 80 questionnaires were produced and distributed to all the respondents. The researcher with the assistance of the lecturers administered the questionnaires and these were collected : on-the-spot. The checklist was also ticked by the lecturers in charge, while seeing facilities, equipment and materials physically along with the researcher. The researcher was able to collect all (100%) of the questionnaires and checklist that were administered.

3.6 Data Analysis

Non-parametric statistics was used in the analysis of the data collected for the study. Descriptive statistics of percentage a, while chi-square (x^2) was used to test the hypothesis formulated for the study. The level of significance (a) was fixed at 0.05.

CHAPTER FOUR

DATA PRESENTATION, RESULTS AND DISCUSSION

4.1 Introduction

The purpose of this study was to find out the availability of ceramics equipment I materials in some selected Colleges of Education in the North East geo-political zone of Nigeria. This chapter deals with the analysis of data and its interpretation. Data was collected through the use of both a questionnaire and a checklist. Descriptive statistics of percentages was used to analyze the information obtained through the checklist and the questionnaires, while the Chi-square test (χ^2) was used to test the hypothesis for this study.

4.2 Demographic Analysis of Respondents

Table 4.1 shows the demographic analysis of the respondents in the various Colleges of Education. The respondents were students.

Table 4.1: Demographic Information of the Respondents

AGE	Gashua	Hong	Maiduguri.	Potiskum	Total	%
18-24	12	11	12	10	45	56.25
25-29	8	7	8	9	32	40
30 - 36	-	2	-	1	3	3.75
37 - Above	-	-	-	-	-	-
TOTAL	20	20	20	20	80	100
LEVEL						
NCE 1	8	12	10	6	36	45
NCE2	9	4	7	11	1 i	38.75
NCE 3	3	4	3	3	13	16.25
TOTAL	20	20	20	20	80	100
Specialization						
Ceramics	2	3	3	3	11	13.75
Sculpture	3	3	3	2	11	13.75
Art history				-	-	-
Textile	4	2	2	3	11	13.75
Graphics	5	4	6	5	20	25
Painting	5	5	5	4	19	23.75
Art education	1	3	1	3	8	10
Glass tcch	-	-	-	-	-	
TOTAL	20	20	20	20	80	100

Source: Fieldwork by the Researcher

The table illustrates that 56.25% (45) of the respondents fall within the age bracket of between 18 and 24, 40% (32) of the respondents fall within ages 25 and 29 while 3.75% (3) of the respondents fall within the age bracket of 30 and 36. Furthermore the table shows that 45% (36) of the respondents in NCE 1, 38.75% (31) in NCE 2, and 1625% (13) in NCE 3. The table also shows that 13.75% (11) specialize in ceramics while 13.75% (11) specialise in sculpture, and 13.75% (11) of the respondents specializing in textile. Twenty % (20) of the respondents specialise in graphics, while 23.75% (19) of the respondents specialize in painting and 10% (8) of the respondents were in art education.

4.3 Availability of Ceramics Equipment

S/No	Items	Number of Schools					
		Yes	%	No	%	T	%
1	Potters Wheel-Manual and Electric	3	75	1	25	4	100
2	Clay mixers, mills and blungers	_	_	4	100	4	100
3	Glaze room equipment	2	50	2	50	4	100
4	Special equipment	_	_	4	100	4	100
5	Clay roller	_	_	4	100	4	100
6	Pug mill and extruders	_	_	4	100	4	100
7	Whirlers and spraying equipment	1	25	3	75	4	100
8	Wheel accessories	2	50	2	50	4	100
9	Clay storage	4	100	_	_	4	100
10	Scales	2	50	2	50	4	100
11	Jar crusher	_	_	4	100	4	100
12	Bill mill	_	_	4	100	4	100
13	Shovels	_	_	4	100	4	100

14	Clay trough	3	75	1	25	4	100
15	Clay pit	3	75	1	25	4	100
16	Clay moulds	_	_	4	100	4	100
17	Slabs	2	50	2	50	4	100
18	Wheel barrows	3	75	1	25	4	100
19	Tables	3	75	1	25	4	100
20	Casting machine	_	_	4	100	4	100
21	Filling and smoothing machine	1	25	3	75	4	100
22	Cupboard	3	75	1	25	4	100
23	Burners	3	75	1	25	4	100
24	Kiln	4	100	_	_	4	100
25	Air compressor1	1	25	3	75	4	100
26	Drums/water reservoir	3	75	1	25	4	100

Source: Field work by the Researcher

The results reveal that 3 (75%) of the Colleges of Education have the potters wheels. None of them had a clay mixer, mill and blungers. Two of the Colleges of Education (50%) had glaze room equipment, none had any special equipment, clay rollers or pug mill and extruders. The table also reveals that 1 (25%) of the Colleges of Education had wheel whirled and spraying equipment, 2 (50%) of the Colleges of Education had wheel accessories, 4 (100%) of the Colleges of Education had clay storages, 2 (50%) of the Colleges of Education had scales, while none of them had either X l jaw crusher or ball mill. The table further demonstrates that 4 (100%) of the Colleges of Education had shovels, 3 (75%) of the Colleges of Education had clay trough and clay pit. Table 4.2 further reveals that none of the Colleges of Education had a clay mould, 2 (50%) of the Colleges of Education has a slab and 3 (75%) of them had wheel barrows and tables, while none had casting machine. Furthermore, the table shows that 1(25%) of the

Colleges of Education had filing and smoothing machine, 3 (75%) of them had kiln. The table also reveals that 1 (25%) of the Colleges of Education had air compressor and 3 (75%) had drums/water reservoirs. 4,4 Availability of Ceramics Materials Table 4.3 lists ceramics materials (raw) availaHe in the colleges. It indicates that 4 (100%) of the Colleges of Education had clay, 1 (25%) of them had glazes and 2 (50%) of them had colours. The table also shows that 1 (25%) of the Colleges of Education had oxides, none of them had feldspar and 2 (50%) of them had potters plaster. The table further reveals that 2 (50%) of the Colleges of Education had soda ash, none of them had gum Arabic, glaze binder or silica sand. The table also explains that 3 (75%) of the Colleges of Education had wood ash, 1(25%) of them had colouring oxides, zirconium oxide and zirconium silicate. None of the Colleges of Education had tin oxides.

Table 4.3' List of Ceramics Materials (Raw) Available in the Colleges.

S/No	Items	Number of schools					
		Yes	%	No	%	T	%
1	Clav	4	100	-	-	4	100
2	Glazes	1	25	.5	75	4	100
3	Colours	2	50	2	50	4	100
4	Oxides	1	25	3	75	4	100
5	Fclds]3ar	-	-	4	50	4	100
6	Potters	1	25	3	100	4	100
7	Soda ash	2	50	2	75	4	100
S	Gum Arabic	-	-	4	50	4	TO(T
9	Glaze binder	-	-	4	100	4	100
10	Silica sand	-	-	4	100	4	100
11	Wood ash	3	75	1	25	4	100
12	Colourinu	1	25	3	75	4	100
13	Zirconium	1	25	3	75	4	100
14	Zirconium	1	25	3	75	4	100
15	Tin oxides	-	-	4	100	4	100

Source: Fieldwork by the Researcher

4.5.1 Availability of Tools and Utensils in the Colleges

Table 4.4 illustrates the list of tools and utensils available in the selected Colleges of Education, It shows that 4 (100%) of the Colleges of Education had potters' hands, brushes and cutting wire. It also shows that 2 (50%) of them had bats, 4 (100%) of them had sieves and lawns, 3 (57%) of them had palette knives, scrapers and rulers The table further reveals that 4 (100%) of the .Colleges of Education had sponges and bowls/containers, 2 (50%) of them had calipers, 3 (75%) of them had metal/plastic/wooden ribs. Four (100%) of the Colleges of Education had mortar and pestle, trimming tools, drying boards and Spatula, while 2 (50%) of them had sketching boards and bin trolley. Furthermore, table 4,3 reveals that 3(100%) of the Colleges of

Education had stools, 3 (75%) of them had sketch/drawing books and 4 (100%) of them had pencils.

Table 4.4 List of Tools and Utensils Available in the Colleges

S/No	Items	Number of Schools					
		Yes	%	No	%	T	%
1	Potters hands	4	100	-	-	4	100
2	Brushes	4	100	-	-	4	100
3	Cutting wire	4	100	-	-	4	100
4	Bats	2	50	2	50	4	100
5	Sieves and lawns	4	100	-	-	4	100
6	Palette knives	3	75	1	25	4	100
7	Scrapers	3	75	1	25	4	100
8	Rules	3	75	1	25	4	100
9	Sponges	4	100	-	-	4	100
10	Bowls/ containers	4	100	-	-	4	100
11	Calipers	2	50	2	50	4	100
12	Metals/plastics/wooden	3	75	1	25	4	100
13	Mortar and pestle	4	100	-	-	4	100
14	Trimming	4	100	-	-	4	100
15	Drying boards	4	100	-	-	4	100
16	Spatula	4	100	-	-	4	100
17	Sketching board	2	50	2	50	4	100
18	Bin trolley	2	50	2	50	4	100
19	Plastic buckets	3	75	1	25	4	100
20	Stools	4	100	-	-	4	100
21	Sketching/drawing books	3	75	1	25	4	100
22	Pencils	4	100	-	-	4	100

Source: Fieldwork by the Researcher

4.6 Availability of Safety and Hygiene Materials in the Colleges of Education.

Table 4.5 shows the list of safety and hygiene materials available in the Colleges of Education Colleges. The table reveals that 4 (100%) of the colleges had aprons, while none had goggle for use. It also shows that 4 (100%) of (75%) of them had hand gloves. Four (100%) of the Colleges of Education had hand trowels and 1 (25%) of them had pair of boots. The table further indicates that 4 (100%) of the Colleges of Education had plastic buckets.

Table 4.5 List of Safety and Hygiene Materials available in the Colleges

S/No	Items	Number of Schools					
		Yes	%	No	%	T	%
1	Clay	4	100	-	-	4	100
2	Goggles	-	-	4	100	4	100
3	Vaseline	4	100	-	-	4	100
4	Hand gloves	3	75	1	25	4	100
5	Hand trowels	4	100	-	-	4	100
6	Pair of boots	1	25	3	75	4	100
7	Plastic buckets	4	100	-	-	4	100

Source: Fieldwork by the Researcher

4.7 Analysis of the Opinions of Respondents on the Availability, Functionality and Adequacy of Facilities, Equipment and Materials for Teaching Ceramics

Table 4.6 explains the opinions of respondents on the availability of facilities for teaching ceramics in Colleges of Education in the North-east geo-political zone of Nigeria. The mean score of respondents on the availability of ceramic hand building facilities is 3.45, which shows that they were available in the schools. The mean score for responses on the availability of facilities for ceramic throwing is 3.34, which indicates that they were also available. The mean score for responses on the availability of facilities for teaching ceramics is 3.39, this proves that they were available. The mean score for the responses on the availability of facilities for ceramic firing is 3.99, which demonstrates that they were available. The table also confirms the mean of the responses on the availability of facilities for clay mixing is 3.6, this shows that they were available.

Table 4.6: Availability of Facilities for Teaching Ceramics in the Colleges of Education

S/N	Availability of facilities for teaching ceramics	SA	%	A	%	U	%	DA	%	SD	%	T	%	Mean
1	Facilities for teaching ceramic hand building are available	10	12.5	46	57.5	3	3.75	12	15	9	11.25	80	100	3.45
2.	facilities for teaching ceramic throwing are available	7	8.75	46	57.5	2	2.5	17	31.25	8	10	80	100	3.34
3.	Facilities for materials for teaching ceramics are available	9	11.25	44	55	1	31.25	21	26.25	5	6.25	80	100	3.39
4.	Facilities for teaching ceramic firing are available	9	11.25	65	81.25	2	2.5	4	5	-	-	40	100	3.99
5.	Facilities for clay mixing are available	14	17.5	42	52.5	4	5	18	22.5	2	2.5	80	100	3.6

Source: Fieldwork by the Researcher

Table 4.7 reveals the opinions of respondents on the availability of equipment for teaching ceramics. The mean score for responses on the availability of hand building equipment is 3.95, which shows that they were available. The mean score for responses on the availability of throwing equipment for teaching ceramic is 3.94, which indicates that they were available. The mean score for responses on the availability of equipment for teaching ceramic firing is 3.93, which shows that they were available. The mean score for responses on the availability of equipment for teaching clay-processing is 2.01, this proves that they were not available. The mean score for responses on the availability of equipment for teaching clay mixing is 1.76, which shows that they were not available.

Table 4.7 Availability of Equipment for Teaching Ceramics in the colleges of Education

S/N	Availability of equipment	SA	%	A	%	U	%	DA	%	SD	%	T	%	Mean
1	Equipment for teaching ceramic hand building are available	10	12.5	61	76.25	4	5	5	6.25	-	-	80	100	3.95
2.	Equipment for teaching ceramic throwing are available	9	11.25	63	78.75	3	3.75	4	5	1	1.25	80	100	3.34
3.	Equipments for teaching ceramics firing are available	13	16.25	55	68.75	6	7.5	5	6.25	1	1.25	80	100	3.93
4.	Equipment for teaching ceramic clay processing are available	-	-	5	6.25	2	2.5	62	77.5	11	13.75	80	100	2.01
5.	Equipment for teaching ceramic clay mixing are available	-	-	-	-	6	7.5	52	65	22	27.5	80	100	1.76

Source: Fieldwork by the Researcher

Table 4.8 illustrates the opinion of rerspondents on the availability of materials teaching ceramics. the mean score of responses on the availability of equipment for teaching ceramic glazing is 2, which shows that they were not available. The mean score for responses on the availability of equipment for teaching ceramic decoration is 2.29, which means that they were not available. The mean score for responses on the availability of equipment for teaching ceramic hand building is 2.81, this demonstrates that they were not available. The score for responses on the availability of equipment ceramic is 2.76, which reveals that they were not available.

Table 4.8: Availability of Materials for Teaching Ceramics in the Colleges of Education

S/N	Availability of materials for teaching ceramics	SA	%	A	%	U	%	DA	%	SD	%	T	%	Mean
1	Materials for teaching ceramic glazing are available	-	-	58	7.5	2	2.5	58	72.5	14	17.5	80	100	2
2.	Equipment for teaching ceramic decoration are available	-	-	59	17.5	1	1.25	59	73.75	6	7.5	80	100	2.29
3.	Equipments for teaching ceramics hand building are available	2	2.5	32	40	4	5	33	41.25	9	11.25	80	100	2.81
4.	Equipment for teaching ceramic throwing are available	3	3.75	29	36.25	2	2.5	38	47.5	8	10	80	100	2.76

Source: Fieldwork by the Researcher

Table 4.9 illustrates the opinion of respondents on the functionality of ceramic S facilities in the Colleges of Education. The mean score for responses on the functionality 'of facilities for teaching ceramic hand building is 2.14, which shows that they were not functional. The mean score for responses on the functionality of facilities for teaching ceramics throwing is 2.3, which show that they were not functional. The mean score for responses on the functionality of facilities for ceramic materials is 2.16, this shows that they were not functional. The mean score for responses on the functionality of facilities for ceramic firing is 3.69, which shows that they were functional. The mean score for responses on the functionality of facilities for clay processing is 2.15, which shows that they were functional.

Table 4.9 Functionality of Facilities for Ceramic Teaching in the Colleges

S/N	Functionality of facilities for ceramic teaching	SA	%	A	%	U	%	DA	%	SD	%	T	%	Mean
1	Facilities for ceramic hand building are available	4	5	12	15	2	2.5	35	43.75	27	33.75	80	100	2.14
2.	Facilities for ceramic throwing are available	5	6.25	12	15	8	10	32	40	23	28.75	80	100	2.3
3.	Facilities for ceramic materials are available	4	5	13	16.25	2	2.5	34	42.5	27	33.75	80	100	2.16
4.	Facilities for ceramic firing are functional	12	15	50	6.25	4	5	10	12.5	3	3.75	80	100	3.69
5.	Facilities for clay processing are functional	3	3.75	11	13.75	2	2.5	53	66.25	11	13.75	80	100	2.15

Source: Fieldwork by the Researcher

Table 4.10 shows the opinion of respondents in the functionality of equipment for the teaching of ceramics in the colleges. The mean score for responses on the functionality of equipment for teaching ceramic hand building is 2.85, which shows that they were not functional. The mean score for responses on the functionality of equipment for teaching ceramics throwing is 3,29, which shows that they were functional. The mean score for responses on the functionality of equipment for teaching clay processing is 2.58, this shows that they were functional. The mean score for responses on the functionality of equipment for teaching clay mixing is 2.25, which indicates that they were not functional. The mean score for responses on the functionality of equipment for teaching ceramic firing is 3.51, this shows that they were functional. The mean score for responses on the functionality of the glazes for teaching ceramics is 2.49, which shows that they were functional.

Table 4.10: Functionality of Equipment for Ceramic Teaching in the Colleges of Education

S/N	Functionality of equipment	SA	%	A	%	U	%	DA	%	SD	%	T	%	MEAN
1	Equipment for teaching	3	3.75	32	40	2	2.5	36	45	7	8.75	80	100	2.85
2	Equipment for teaching	12	15	34	42.5	4	5	25	31.25	5	6.25	80	100	3.29
3	Equipment for teaching	5	6.25	24	30	1	1.25	32	40	18	22.5	80	100	2.58
4	Equipment for teaching	2	2.5	10	12.5	5	6.25	52	65	11	13.75	80	ino	2.25
5	Equipment for teaching	10	12.5	49	61.25	1	1.25	12	15	8	10	80	100	3.51
6	The glazes for teaching	4	5	16	20	6	7.5	43	53.75	11	13.75	80	100	2.49

Source: Fieldwork by the Researcher

Table 4.11 shows the opinions of respondents on the adequacy of facilities, equipment and materials for teaching ceramics in the Colleges of Education. The mean score for the responses on the adequacy of facilities is 2.35, which reveals that they are inadequate. The mean score for the responses on the adequacy of materials for teaching ceramics is 2.45, this illustrates that they were inadequate. The mean score for the responses on the adequacy of materials for teaching ceramic hand building and throwing is 2.41, this proves that they were inadequate. The mean score for the responses on the adequacy of materials for teaching ceramic glazing and decoration is 2.13, which shows that they were inadequate. The mean score for the responses on the adequacy of Equipment for firing is 2.2, this confirms that they were inadequate.

Table 4.11 Adequacy of Facilities, Equipment and Materials for Teaching Ceramics

S/N	Adequacy of facilities, equipment and materials	SA	%	A	%	U	%	DA	%	SD	%	T	%	Mean
1	There arc adequate facilities for teaching ceramics	1	1.25	17	21.25	8	10	37	46.25	17	21.25	80	100	2.35
2	There are adequate materials for teaching ceramics	2	2.5	21	26.25	6	7.5	33	41.25	18	22.5	80	100	2.45
3	There are adequate materials for teaching hand building	5	6.25	12	15	9	11.25	39	4825	15	18.75	80	100	2.41
4.	There are adequate materials for teaching ceramic glazing and	-	-	9	11.25	5	6.25	53	66.25	13	16.25	80	100	2.13
5	There are adequate equipment for firing	4	5	10	12.5	4	5	42	52.5	20	25	80	100	2.2

Source: Fieldwork by the Researcher

4.8 Chi-Square Analysis of the Opinions of Respondents on the Availability, Functionality and Adequacy of Facilities, Equipment and Materials in the Colleges of Education.

Analysis of the opinions of respondents on the availability, functionality and adequacy of facilities, equipment and materials in the colleges of education was done using percentages and chi-square (χ^2). Table 4.12 shows the chi-square analysis of responses in table 4.6. The results reveal that 56 (69.4%) of the respondents agreed while 124(30.6%) respondents disagree that there are facilities, equipment and materials. The calculated is χ^2 6.05, while the χ^2 critical value is 7.82. This result demonstrates that the χ^2 calculated value is less than χ^2 critical value. Therefore, the null hypothesis which states that there is no significant difference in the opinion

of the respondents towards availability of facilities, equipment and materials in the Colleges of Education is retained

Variable	A	%	DA	%	Df	A	χ^2 calculated	χ^2 critical	Decision
Availability of facilities pieces of equipment and materials	56	69.4	24	30.6	3	0.05	6.05	7.82	Not significant

A - Agree, DA - Disagree, Df- Degree of freedom

Table 4.13 shows the summary of chi-square analysis of the opinions of respondents on the adequacy of existing materials and equipment in the colleges. The table reveals that 28 (35%) of the respondents agree that the materials and equipment were adequate, while 52 (63%) disagreed. The obtained χ^2 was 39.32, which was greater to the critical χ^2 of 7.82. Therefore the null hypothesis that states that there is no significant difference in the opinions of respondents on the adequacy of existing materials aid equipment is rejected.

Table 4.13; Summary Table of Chi-square Analysis of Responses on the Adequacy of Existing Materials and Pieces of Equipment.

Variable	A	%	DA	%	Df	A	χ^2 calculated	χ^2 critical	Decision
Adequacy of Facilities pieces of equipment and materials	28	35	52	65	3	0.05	39.32	7.82	Significant

A - Agree, DA - Disagree, Df- Degree of freedom

Table 4.14 displays the summary table of chi-square analysis of the responses on the proper functioning of existing equipment in the colleges of education. It is shows that 23 (28%) of the respondents agree, while 59 (72%) disagreed about the proper functioning of existing equipment and materials is rejected.

Table 4.14: Summary table ofchi-square analysis of responses on the functionality of facilities, materials and pieces of equipment

Variable	A	%	DA	%	Df	α	χ^2 calculated	χ^2 critical	Decision
facilities, pieces of equipment and materials	23	28	59	72	3	0.05	24.6	7.82	Significant

A - Agree, DA - Disagree, Df- Degree of freedom

From table 4.15 above the responses of students on the problems associated with use and maintenance of facilities, equipment and materials in the colleges are analyzed. This was done through the grouping of responses made by the students. It can observed that 18 (22.5%) of the students were of the opinion that an insufficient equipment is one of the problems facing the use of the pieces of equipment, facilities and materials. Forty-three students (53.75%) opined that it is due to poor standard of equipment. Eight students (10%) believe it is due to the poor culture acquiring equipment meet the growing demand for them while allowing the available ones to grow fallow. Six students (7.5%) are of the opinion that it is due to dependence on manual production instead of mechanized production. Five students (6.25%) believed that it is because the equipments were old and outdated.

4.15: Responses of Students on the Problems Associated with the use and Maintenance of Facilities. Equipment and Materials in the Colleges.

Responses	No of Students	%
Insufficient equipment	18	22.5
Poor standard of equipment	43	53.75
Culture of not acquiring equipment to meet the growing demand for them	8	10
Dependence on manual production instead of mechanized production	6	7.5
Equipments are old and outdated	5	6.25
Total	80	100

Source: Fieldwork by the researcher

Discussion of Findings

From the analysis of data collected through the check list and the questionnaire, some pertinent facts had emerged. This section of the study discusses the findings in relation to the research questions. The study shows that there were some facilities, equipment and materials for teaching ceramics in the colleges. These materials and equipment included those proffered by the Potters Materials and Equipment (1990) and Alasa (2006). The equipment available in all the schools selected for the study includes clay storages, shovels and kilns and so forth. Others present in some schools were potters wheel, clay trough, clay pit, wheelbarrows, table, cupboards burners and drums/ reservoir 1 for water (see Plates 1-13)

Plates 1- 3: Some of the Materials and Equipment Available in COLLEGE OF EDUCATION GASHUA, YOBE STATE

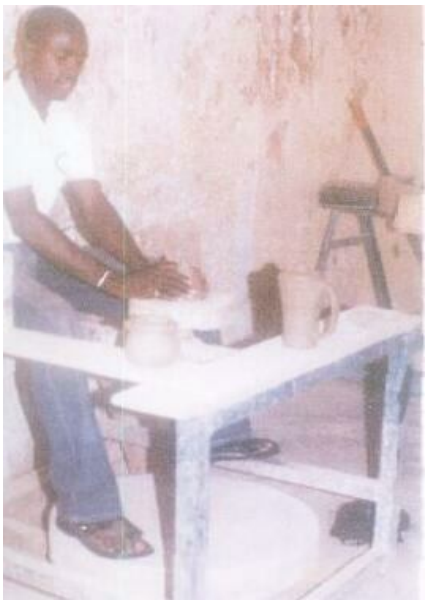


Plate 1: Potter's Wheel



Plate 2: Kiln



Plate 3: Clay Material

Plates 4 and 5: Some of the Materials and Equipment Available in **COLLEGE OF EDUCATION HONG, ADAMAWA STATE**

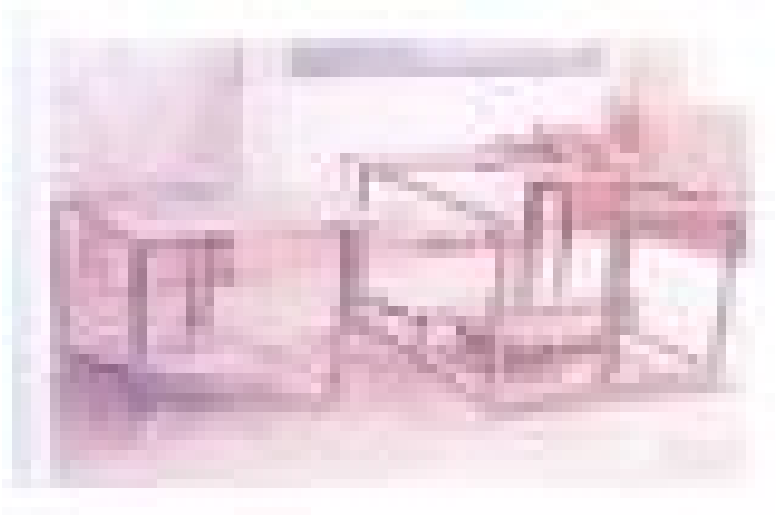


Plate 4: Potter's Wheel



Plate 5: Kiln

Plates 6 - 9: Some of the Materials and Equipment Available in Federal College of Education (Technical) Potiskum, Yobe state



Plate 6: Glaze Materials



Plate 7: Kiln

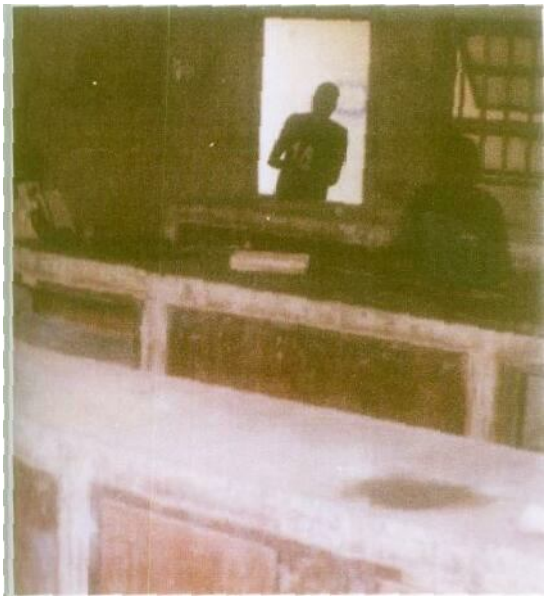


Plate 8: Studio



Plate 9; Potter's Wheel

Plates 10-13; Some of the Materials and Equipment Available in **KASHIM IBRAHIM COLLEGE OF EDUCATION, MAIDUGURI, BORNO STATE**

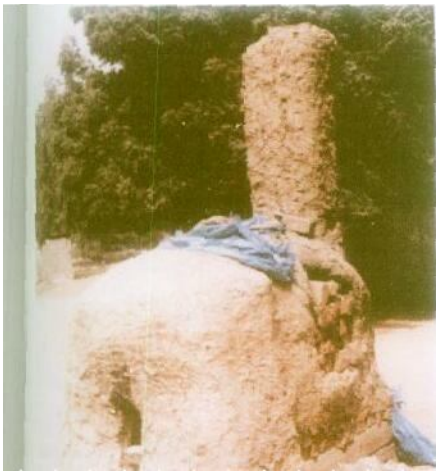


Plate 10: Kiln



Plate 11: Clay



Plate 12: Potter's Wheel



I

Plate 13: Studio

The potter locally makes most of this equipment with a good description of the information gotten. However, College of Education Gashua, did not have some of the required equipment such as clay mixers, mills and blungers, special equipment clay rollers, pug mill and extruders, jaw crusher, ball mill, clay moulds and casting machines while others were in such poor quality like the whirler and spraying equipment, filing and smoothing machine and air compressor. The non-availability of the machines will greatly reduce the effectiveness of teaching in the schools without this equipment.

The findings revealed that there were some ceramic materials in the Colleges of Education. Clay was available in all of the Colleges of Education. This may be due to its existence in free or commercial quantities of clay in the country. This is followed by wood ash, which was present in three of the selected Colleges of Education. Other materials such as feldspar, gum Arabic, glaze binder, silica sand and zirconium silicate were not available in any of the colleges. This finding shows that there were some materials but in poor quantity to suit the needs of the students who are expected to learn the use of such materials.

From the checklist used for the study, it was observed that nearly all the schools had the tools and utensils. However, only some colleges had tools such as bats, calipers,

fetching boards and bin trolleys. This shows that the tools and utensils were present in the colleges. None of the Colleges of Education had goggles, which are safety materials. Bowevcr, all the colleges had aprons. Vaseline, hand trowels and plastic buckets From (i.e. analysis of the checklist, it can be observed that there were some of the equipment, facilities and materials for ceramics in some of the selected Colleges of Education.

From the analysis of the responses it was observed that there were facilities, equipment and materials for teaching ceramics in the colleges. These materials and equipment were however, not adequate for the teaching and learning needs of the students in the colleges. It was also observed from the responses that the problems associated with the use and maintenance of equipment, facilities and materials are insufficient equipment, poor standard of equipment, the culture of not acquiring equipment to meet the growing demand for them, dependence on manual production instead of mechanized production and the obsolescence of equipment, thus making the acquisition of their parts very difficult. It could be concluded that without adequate [5] provision of equipment, facilities and materials for the teaching of ceramics, proper teaching and learning will be hampered or made almost impossible. Even when the equipment and materials are available, nothing will be achieved by their mere existence in the Colleges of Education as they were both inadequate and did not function properly. This will make teaching and learning a difficult and uphill task for both the lecturers and the students.

CHAPTER FIVE

Summary, Conclusion and Recommendations

5.1 Summary

This study was aimed at finding out the availability of facilities, equipment and materials in the colleges of education, the adequacy of existing equipment and materials, It level of functionality of the existing equipment and materials and to find out the problems associated with the use of these equipment and materials in the Colleges of Education in the North-East Geo-political zone of Nigeria. The researcher employed the survey method of research in carrying out the study and employed the use of the questionnaire and checklist as means of data collection.

Analysis of data generated from the study revealed that there were facilities, equipment and materials for teaching ceramics in the colleges. These equipments and facilities were found to be inadequate and not functioning properly. The major problem associated with the use of these equipments is poor maintenance of the equipment. Other factors include poor standards of the equipment, too much of reliance on manual instead of mechanized production of ceramics and insufficient equipment. Analysis of the data was through the use of percentages and means, and the hypothesis was tested using the chi-square test.

5.2 Conclusion Based on the findings of this study, the researcher drew the following conclusions:

1. There were facilities and equipment for teaching ceramics in the colleges.
2. The facilities, equipment and materials in the colleges were not adequate to cater for the needs of the students.
3. The facilities and equipment in the colleges were not functioning properly for their effective use in teaching ceramics.

4. Problem of insufficiency, poor standards of equipment and facilities and too much reliance on manual instead of mechanized ceramics production affected the use of equipment in the teaching of ceramics in the Colleges of Education.

5.3 Recommendations

Based on the results of this study, the following recommendations were made:

i. Based on the inadequacy of the existing facilities and equipment in the colleges, more variety (in terms of sizes) should be provided. This is to ensure that the basic facilities and equipment that are capable of being used for teaching the production of a variety of sizes and quantities of ceramic pieces are present in all the Colleges of Education.

ii. The facilities, materials and equipment to be provided should be adequate (in terms of quantity) for meaningful learning to take place in the Colleges of Education.

iii. The facilities, materials and equipment should be properly maintained to ensure their proper functioning**.**

iv. The use of modem techniques, especially the techniques of mass reproduction and quality control, in ceramic production should be encouraged in the Colleges of Education.

v. In tandem with modem day scientific development, electrically operating equipment should be provided because they will enhance teaching and learning processes in the Colleges of Education.

5.4 Suggestions for Further Research

1. Perception of teachers on the quality of instruction of ceramic courses in Colleges of Education.

2. Knowledge and performance of the use of ceramic equipment and materials by ceramics teachers.

3. Constraints in the development of ceramics education in Nigeria.

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APPENDIX A

SOME OF THE BASIC SAFETY AND HYGIENE MATERIALS IN CERAMIC TEACHING

- Apron: A piece of clothing worn over the front body from the chest or the waist down and tied around the waist. Aprons are worn over other clothes to keep them clean, usually when working in the studio and when firing.
- Goggles: A pair of glasses that fit closely to the face to protect the eyes from | wind, that dust, water, cheeped pieces or particles from the eyes.
- Vaseline: A thick soft clear substance that is used on the skin to heal or protect it, or as a lubricant to stop surfaces from sticking together. It throwing and after working with the clay that involve direct contract with the hand to avoid cracks on the hands.
- Glazing claws: A pairs of gloves worn on the hands by the potter to avoid direct hands contact with the glazes or other chemical materials.

- Bin trolleys: A container on wheels that you put waste in like dustbin.
- Plastic buckets: A round open container with hand, used for carrying or holding liquids, sands, clay etc.
- Books: A written work published in printed or electronic form to get information when required.

SOME BASIC EQUIPMENT REQUIRED IN CERAMIC TEACHING:

1. Blungers: Machine for stirring and mixing ceramics materials usually the ingredients of clay with water.
2. Wheel potter's: A rotating disc on which pots are formed.
3. Clay mixers: Machines for mixing of clay
4. Glaze room equipment: Room where equipment for glazes are being kept
5. Special equipment: These are equipment made special for their special functions
6. Clay rollers: They are rollers for rolling clays and glaze when the need arises.
7. Pugmill: A machine for mixing and compressing plastic clay.
8. Whirler: A heavy turntable used in press molding it revolves slowly and steady because of its weight. A faculty plate saucer etc which will spine round on a central part instead of standing firmly on its foot rim. It is the opposite of a hamper.
9. Spraying equipment: Machine used for spraying glazes, colours etc. on pottery products
10. Wheel Accessories: These are wheel parts
11. Extruders: Used for forcing clay through a disc to give a desired cross section.
12. Ball mill: A grinder mill used for the fine grinding of glaze.
13. Scales: An instrument for weighing things like clays, glazes and colour materials oxides and others for ceramics components.
14. Kiln: A furnace for firing ceramic products. A structure built to conserve heat.
15. Clay Storage: Where clays are stored

BAS1C CERAMIC RAW MATERIALS

1. Clay: Is a mineral with a crystal structure, but can not be seen with the naked eye
    a. or even through a magnifying glass.
2. Glaze: A layer of glass, which is fused into place on a pottery body.
3. Colour: Ceramic colours metal oxides and prepared stains used to colour bodies, slips, glazes and enemals. Some clay **are** naturally coloured by iron and manganese.
4. Oxide: A chemical combination of there are two types of oxide, the metal oxide and the non-metal oxide, the metal oxide are numerous and form the flutes, colouring and the glass-formers and the volatiles. Feldspar: A group of minerals used in proportions of up to 25% as fox in bodies and up to 100% in glazes.
5. Soda: A general term covering the sodium compounds of Soda ash (sodium Carbonate) Na_2CO_3: washing soda (sodium carbonate) Na_2CO_3. $10H_2O$ baking soda (Sodium bicarbonate) $NaHCO_3$: caustic soda (sodium hydroxide) NaOH.
6. Silica: Silicon dioxide. SiO; The glassy substance, which is the most important constitution of pottery, glazes and which is integral part of clay and many potter's mineral. It occurs naturally as quartz rock, flint and sand. It also occurs in combination with other oxides in what are called silicate
7. Wood ash: the inorganic residue after the combustion of the organic structure of wood. The term is popularly extended to include other vegetable ashes, e.g. grass, reed and straw.
8. Colouring oxides:- metal oxides, which impart colour to the fired ceramics, e.g. cobalt oxide gives, blue.
9. Zirconium oxide: zroz and pacifier, which is similar in properties to tin oxide. Zirconium is a metal with a high melting point.
10. Zirconium silicate: zircon. Zro;. SiO;. a mineral associated with igneous rocks. It is highly refractory and harder than quartz. Large crystals, which are colourless, can be cut as gemstone.
11. Tin oxide: white tin oxide SnOz (previously called stannic oxide). The normal or fully oxidized state of the metal tin. This a metal S.C.M.C. with a low melting point. The whiting tin oxide acts as an acid or anti-flux thereby stiffing the melt and dissolving slowly.
12. Tin oxide black: So the gray or black oxide of tin. The black tin oxide acts as a flux and is quicker to dissolve in the glaze.
13. Tin ash: A mixture of tin oxide and lead oxide. It is a brown colour but gives white opacity to glazes when the lead oxide fluxes the silicates and the tin oxide
14. remains as suspended articles.
15. Cones parametric cones: Elongated three sided pyramids, 2 to § Sin tall, which are placed inside a kiln as a measurement of heat-work,
16. Glaze binder: S.C.M.C sodium carboxymethyleelluose (2) suspender
17. Bentonite: highly plastic clay originating in the decomposition of volcanic ash. It extremely fine and can be dispersed widely through bodies and glazes.
18. Alumina: oxide of aluminum Ah 0. One of the essential ingredients of all clays and glazes.

19. Ball clay,- secondary or sedimentary clay which is very plastic. Alone, it is too fine and slippery for use. Additions of sand, grog and coarser and less plastic clays improve the workability.
20. Granite: an acid rock with high silica content contains the ingredients of pottery e.g. feldspar, stone, quartz. Originates from a molten magma which cools slowly within the earth and is therefore of large crystalline grain.
21. Kaolin: Chain clay Al_2O_3, 2slO2, 24_20 purest clay, contains very little iron impurity, it is derive from the Chinese "kao" and "Ling-hill". A ridge of mountain, where the white clay was first discovered in its purest form. it is white when fired.
22. Porcelain: vitrified, white and translucent ware. It is kaolin and silica with little flux fired to verification point 1300°C.
23. Quartz: A natural crystalline silica Sioz or sand used as sources of silica for glazes and bodies.
24. Slip: any clay or body mixed with water to a smooth consistency.

METHODS OF PROCESSING, CERAMIC

1. Burnishing: The polishing of the surface of clay ware by rubbing with hand spatula, glass, spoon, or any smooth tool when it is in the leather hard stage.
2. Centering: Pressure applied to a ball of clay on the wheel as it spins to persuade the whole mass to run true.
3. Coiling: An age-old technique of building by laying coils or ropes of clay one upon another and working them together to form a definite shape.
4. Decomposition;- The breaking up of chemical compounds e.g. it is the decomposition of granite rock which forms clay
5. Hand- building: A convenient term for the forming of ceramic with out a wheel. This include coiling, pinching, slab-building, molding or combination.
6. Pinching: Pressing clay between the thumb of the finger into the desired shape. 1.
7. Throwing: The method of shaping pottery on the potter's wheel using only the hand potter and water for lubrication.
8. Firing: the process of conversion from clay to pot. It involves heat of at least $600^0C(1112^0F)$.

SOME OF THE BASIC TOOLS REQUIRED IN CERAMIC TEACHING

1) Potter's hands: the potter's physical hands for the pottery making and other things.
2) Brushes: object made of short stiff hairs or wires set in block of wood or plastic, usually attached to a handle used for many different jobs such as cleaning painting and designing or decorating ceramic products.
3) Sieve(s): a frame or rim with a lawn(s) or fine mesh across it used for separating by size the coarsen materials from fine or unwanted from wanted etc.
4) Palletter knives: wooden or metal knives used for cutting or removing unwanted object from the clays and others
5) Scrapper: A tool used for scrapping clays and other materials on slabs or on surface of other objects

6) Rubber kidney: molder's kidney. A-flat kidney -shaped piece of rubber for pressing slabs of clay into or onto moulds.
7) Sponge: A piece of artificial or natural material that is soft and light and full of holes and can hold water easily used to absorb water in the pots when throwing and for cleaning ceramics products where necessary.
8) Bat: A common word with many meanings in the pottery. It implies a flat surface and is used foi kiln shelf, pot bond, and detachable wheel head and pot beater.
9) Turning tools, tools used for trimming, shaving, removing unwanted clay to achieve a particular form, thin a pot wall or created a foot rim etc.
10) Bowl: Container, deep dish used for holding water and throwing tools when throwing pots. Preferably plastic.
11) Hand towel: A small piece of material for cleaning your hands okey after working with clays and other materials.
12) Wooden ribs: Any object or tool, such as a piece of slate, metal or wood used in throwing pots on the wheel. Originally animal ribs were used.
13) Mortar and pestle: A small hard bowl in which you can crush substances such as clays glazes and other materials when the need arises into powders with a special object called a pestle. The pestle is a small heavy tool with a round end used for crushing things in a mortar.
14) Drying board: Flat piece of strong hard wood, used for drying pots after thrown and any other wet objects or products to be placed upon for drying.
15) Polythene: A synthetic material, useful, cheap and a blessing to a potter. It eases the problem of keeping pots and clay moist.
16) Roulette: A tool for producing a repeat decoration impressed pattern when rolled over a clay produces the pattern.
17) Books: A written work published in printing or electric form to get information when required.
18) Logbook: A record keeping book for noting the date, firing time, weather conditions, the kind of wares that was fired and the results (Frank and Janet, 2002, Counts, 1974, Fulham Pottery, 1671; Alasa, 2005).

APPENDIX B

QUESTIONNIARE ON EVALUATION OF CERAMIC FACILITIES, EQU1PMENT AND MATERIALS IN SOME SELECTED COLLEGES OF EDUCATION IN THE NORTH-EAST GEO-POLITICAL ZONE OF NIGERIA

SECTION A

DEMOGRAPHIC INFORMATION

Instructions: In this section, you are to supply demographic information. Please responses would be strictly used for research purposes and be treated with high a level of confidentiality.

1. Name of College: .....
2 Age: 18-24[ ] 25-29 [ ] 30-36 [ ] 37 and above [ ]
3. Level: NCE 1 [ ] NCE 11[ ] NCE 111 [ ]
4. Area of specialization: Ceramics [ ] Sculpture [ ] Art history [ ] Textile [ ]
   Graphics [ ] Painting[ ] Art education [ ]
   Glass technology [ ]

SECTION B

Please tick to indicate your level of agreement or disagreement with the statements Provided

Key

SA: Strongly agreed. A; Agreed, U: Undecided, DA: Disagreed,

SD: Strongly disagreed

S/No	Availability of facilities for teaching ceramics	SA	A	U	DA	SD
1,	Facilities for teaching ceramic hand building are available					
2.	Facilities for teaching ceramic throwing are available					
3.	Facilities for materials for teaching ceramics are available					
4.	Facilities for teaching ceramic firing are available					
5.	Facilities for clay mixing are available					

S/No	Availability of equipment for teaching ceramics	SA	A	U	DA	SD
1	Equipment for teaching ceramic hand building are available					
2.	Equipment for teaching ceramic throwing are available					
3.	Equipment for teaching ceramic firing are available					
4.	Equipment for teaching ceramic clay processing are available					
5.	Equipment for teaching ceramic clay mixing are available					

S/No	Availability of materials for teaching ceramics	SA	A	U	DA	SD
1.	Materials for teaching ceramics glazing are available					
2.	Materials for teaching ceramics decoration are available					
3.	Materials for teaching ceramics hand building are available					
4.	Materials for teaching ceramics throwing are available					

S/No	Functionality of facilities for ceramic teaching	SA	A	U	DA	SD
1.	Facilities for ceramic hand building are functional					
2.	Facilities for ceramic throwing are functional					
3.	Facilities for ceramic materials are functional					
4,	Facilities for ceramic firing are functional					
5.	Facilities for clay processing are functional					

S/No	Functionality of equipments for ceramic teaching	SA	A	U	DA	SD
1.	Equipment for teaching ceramic hand building is functional.					
2.	Equipment for teaching ceramic throwing is functional.					
3.	Equipment for teaching ceramic clay processing is functional.					
4.	Equipment for teaching ceramic clay mixing is functional.					
5.	Equipment for teaching ceramic firing is functional.					
6.	The glazes for teaching ceramics are functional					

What are the problems associated with the use and maintenance of the facilities, equipments and materials? _____

_____

_____

_____

APPENDIX C

CHECKLIST FOR THE EVALUATION OF CERAMIC EQUIPMENT AND MATERIALS IN SELECTED COLLEGES OF EDUCATION IN NORTH-EAST GEO-POLITICAL ZONE OF NIGERIA

Name of College:.....

List of ceramic equipment:

S/N	Equipment	Available	Not Available
1.	**Potter's wheels - manual and electric wheel**		
2,	**Clay mixers, mills and blungers**		
3.	**Glaze room equipment**		
4.	**Special equipment**		
5.	**Clay rollers**		
6.	**Pug mill and extruders**		
7.	**Whirlers and spraying equipment**		
8.	**Wheel accessories**		
9.	**Clay storages**		
10	**Scales**		
11.	**Jaw crusher**		
12.	**Ball mill**		
13.	**Shovels**		
14.	**Clay trough**		
15.	**Clay pit**		
16.	**Clay moulds**		
17.	**Slabs**		
18.	**wheel barrows**		
19.	**Tables**		
20.	**Casting machine**		
21.	**Filing or smoothing machine**		
22.	**Cupboards**		
23.	**Burners**		
24.	**Kiln**		
25,	**Air compressor**		
26.	**Drums/reservoir**		

List of ceramic materials (Raw)

S/No	Ceramic materials	Available	Not available
1.	Clay		
2,	Glazes		
3.	Colours		
4.	Oxides		
5.	Feldspar		
6.	Potters plaster		
7,	Soda ash		
8.	Gum Arabic		
9.	Glaze binder		
10.	Silica sand		
11.	Wood ash		
12	Colouring oxides		
13.	Zirconium oxide		
14.	Zirconium silicate		
15.	Tin oxides		

List of tools and utensils

S/No	Tools and utensils	Available	Not available
1.	Potters hands		
2,	Brushes		
3.	Cutting wire		
4.	Bats		
5.	Sieves and lawns		
6.	Palette knives		
7,	Scrapers		
8.	Rulers		
9.	Sponges		
10.	Bowls/containers		
11.	Calipers		
12	Metal/plastic/wooden ribs		
13.	Mortar and pestle		
14.	Trimming tools		
15.	Drying board		
16.	Spatula		
17.	Sketching board		
18.	Bin trolley		
19.	Plastic baskets		
20.	Stools		
21.	Sketch/drawing books		
22.	Pencils		

List of safety and hygiene materials

S/No	Safety and hygiene materials	Available	Not available
1.	Apron		
2,	Goggles		
3.	Vaseline		
4.	Hand gloves		
5.	Hand towels		
6.	Pair of boots		
7,	Plastic buckets		

Adapted from: Potter's materials and equipment (1990), Fulham Pottery (1671). Alasa (2005), Nelson (1996), Singer and Singer (1971), Emodah (2006), Frank and Janet (2002).

APPENDIX D

Map of North East Geopolitical zones showing the location of the four Colleges Education for the study.

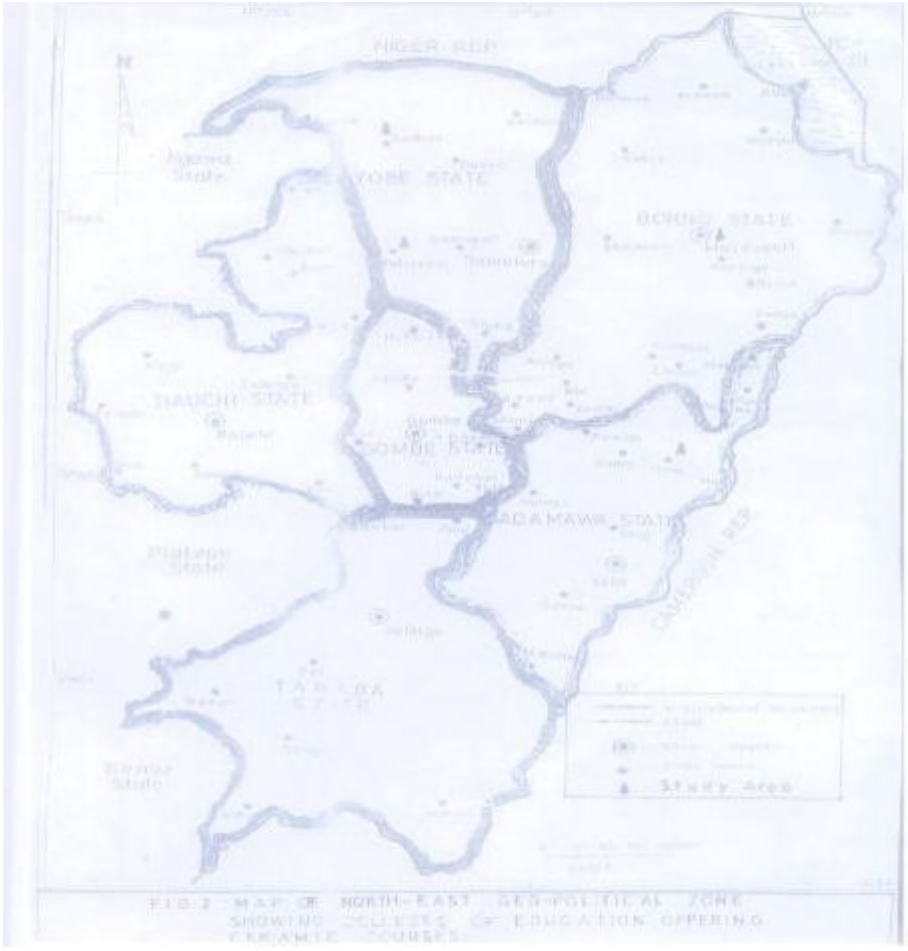


Fig 1

APPENDIX E

Data coding sheet for evaluation of facilities and materials for teaching ceramics in some selected colleges of Education in the North-East Geo-political zone

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34
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Data coding sheet for evaluation of facilities and materials for teaching ceramics in some selected colleges of Education in the North-East Geo-political zone

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Data coding sheet for evaluation of facilities and materials for teaching ceramics in some selected colleges of Education in the North-East Geo-political zone

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69	1	1	2	7	5	5	5	5	4	5	5	4	2	1	3	4	2	4	4	4	4	5	4	2	5	4	4	5	4	4	4	5	4	5
70	1	1	3	7	5	5	5	5	4	5	5	4	4	3	4	4	3	4	5	5	5	5	4	2	5	4	5	5	4	4	4	5	4	5
71	2	3	2	2	5	3	2	4	2	4	4	4	2	2	2	2	2	5	2	1	1	4	2	2	5	2	5	1	2	1	2	2	1	2
72	2	1	2	2	4	4	3	4	3	4	4	4	2	2	1	2	2	2	1	2	1	4	2	2	2	2	2	1	2	1	1	2	1	2
73	2	1	4	1	4	4	4	4	3	4	4	4	2	2	2	2	2	2	1	2	1	4	2	2	2	2	2	2	2	2	2	1	1	2
74	2	2	2	6	4	4	4	4	4	4	4	4	2	2	1	2	2	2	1	2	2	4	2	1	2	2	2	2	2	2	1	2	2	2
75	2	2	1	7	4	4	4	4	4	4	4	4	2	2	2	1	2	2	1	2	2	4	1	2	1	2	2	2	2	2	1	2	1	1
76	2	2	1	7	2	1	2	2	2	2	2	3	1	1	2	2	1	1	2	1	1	1	2	2	2	1	1	1	1	1	1	2	2	2
77	2	1	1	7	2	1	2	2	2	2	2	1	1	1	2	2	1	1	2	1	1	2	2	2	4	1	2	2	1	1	2	2	2	2
78	7	2	1	7	2	1	2	2	1	2	2	1	1	1	2	2	1	2	2	1	1	2	2	2	4	1	2	4	1	1	1	2	2	2
79	2	6	1	6	2	1	1	4	2	3	3	3	2	1	2	2	2	1	2	1	1	4	2	2	2	1	2	1	2	1	2	2	2	2
80	**2**	**2**	**2**	**7**	**3**	**3**	**2**	**4**	**2**	**4**	**4**	**4**	**2**	**2**	**1**	**2**	**2**	**2**	**2**	**1**	**1**	**2**	**2**	**2**	**2**	**1**	**2**	**1**	**2**	**1**	**1**	**2**	**2**	**2**