UNIVERSITY OF EDUCATION, WINNEBA

CHALLENGES OF CLOTHING AND TEXTILE TEACHERS IN TEXTILES FIBRE IDENTIFICATION AND TESTING LESSONS IN THE HO MUNICIPALITY OF THE VOLTA REGION

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DECLARATION

STUDENT'S DECLARATION

I, Sahadatu Hamza, declare that this dissertation, with the exception of quotations and references contained in published works which have all been identified and duly acknowledged, is entirely my own original work, and it has not been submitted, either in part or whole, for another degree elsewhere.

Signature:………………………………

Date:…………………………………….

SUPERVISOR'S DECLARATION

I hereby declare that the preparation and presentation of this work was supervised in accordance with the guidelines for supervision of dissertation as laid down by the University of Education, Winneba.

Supervisor: Professor Phyllis Forster

Signature:…………………………

Date:………………………………

DEDICATION

To Freeman Adehe and my mother, Adraku Bertha.

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I am particularly thankful to my supervisor, Professor Phyllis Forster for her selfless contributions, patience and guidance amidst her busy schedules without which this dissertation would not have been completed.

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ABSTRACT

Textiles fibre identification and testing lessons at the Senior High School level has challenges that must be addressed to improve clothing and textile education in schools. To find out the nature of challenges and ways to address the issue, the study focused on challenges of Clothing and Textiles teachers in textile fibre identification and testing lessons and adopted a cross-sectional survey design; sampling was purposive and all 31 Clothing and Textiles teachers in 13 Senior High and Technical Schools within the Ho Municipality participated in the study. Data were gathered with a questionnaire and was analysed using SPSS Software (version 20) to generate frequency and percentage tables, charts and graphs to present the findings after the raw data was compiled using a Microsoft Excel 2019 spreadsheet. The study found out that most of the teachers use appropriate teaching methods, predominantly experimentation and demonstration but a few use methods that do not readily promote understanding of the topic by leaners. The study also revealed that, majority (67.74%) of teachers indicated non- availability of well-equipped science laboratories, or where they are available, are always in use by science students due to improper scheduling of classes and difficulties in accessing microscopes. Furthermore, 54.84% of teachers were unable to carry out solubility tests due to non-availability of chemicals. To address these challenges it was recommended that for effective teaching and learning of textile fibre identification and testing, lessons which involve seeing, handling, and manipulating real objects and materials, there should be provision of well-equipped science laboratories, increased time allocation for practical sessions and encouraging Clothing and Textiles students to take elective chemistry as a compulsory subject as this helps in understating and relating concepts in clothing and textiles better.

CHAPTER ONE

INTRODUCTION

1.0 Background to the Study

Laing (2012) stated that technical skills are indispensable tools for development, so any country that aspires to develop technologically must develop its technical and vocational education as a perquisite for enhancing the skills of her citizens. Making reference to the rapid development of Korea, Singapore and the other industrialized Asian countries.

Laing (2012) again exhorts nations to adopt policies that are based on technical and vocational education to train a highly skilled work force to support economic development. Clothing and Textiles is a skill oriented course that can help equip individuals with sellable skills needed for self-reliance (Corbman, 2006).

According to the Clothing and Textile syllabus (2003), the aims of the programme are to train students to acquire knowledge with experience that will develop their competence in textiles selection and use. It also stated that by the end of the three years, students should become aware of carrier opportunities in Clothing and Textiles; acquires basic scientific knowledge in textile fibres; recognized the significances of clothing and textiles; appreciate the creative use of fibre in clothing production and develop appropriate work ethics in the textiles and clothing industry.

Five out of nine aims of the Clothing and Textiles teaching syllabus at the Senior High School level talks about textiles related skills and careers, these show the importance of the aspects of Textiles education at Senior High School level in the country.

Textiles materials are of different kinds and are from different sources, namely: animal (**wool**, silk), plant (**cotton**, flax, jute, bamboo), mineral (asbestos, glass fibre), and synthetic (nylon, polyester, acrylic, **rayon**) (Lansing *et al*.,1999). Because textile materials are from varied sources they possess different characteristics and are for different end uses as such their misapplication and improper care treatment have negative consequences. A good knowledge and understanding of fabric behaviour and characteristics are vital in the design and development of apparels. For instance, a warp knit mesh fabric made of 100% polyester designed to wick moisture away from the skin, with the quick dry ability, makes it ideal for everyday wear and preferred in extreme performance requirements. On the other hand, Georgette is a balanced plain-woven fabric generally made of 100% polyester with high twist yarns give the fabric less smooth appearance used in fashion apparel.

It will also aid producers of apparels to identify the type of fibre and the care to be given in maintaining the fabrics made of particular types of fibre (Textile School, 2010). Generally, garments intended for fashion apparel will have to fulfil some characteristics: such as durability, strength, colour fastness, aesthetics and so forth. These properties are mandatory for everyday use and maintenance for some apparels for example fashion. These textile related factors affect the performance and behaviour of functional apparel.

Textiles have assortment of uses, the most common of which are for clothing and containers such as bags and baskets. In the household, they are used in carpeting, upholstered furnishings, window shades, towels, covering for tables, beds and other flat surfaces (Yong *et al.,* 2007). In addition, the interaction between the human body and garment is significant; this is true for those close-fit garments such as, base layer garments, where thermo-regulation plays a vital role in the performance of an athlete and even in daily life. Human beings all over the world use textile products, hence there is the need to take textiles fibre identification and testing seriously in the teaching of the subject .

1.1 Statement of the Problem

Okai- Mensah *et al*. (2017) found that most textile lessons were thought theoretically when about 60% of the lessons were practically oriented. They also noted that the vibrancy and enthusiasm of students in Textiles Education is depleting currently and that most Senior High Schools (SHSs) and students are getting disillusioned about this decline and many schools are dropping Textiles from their elective subjects. In the West African Examination Council (WAEC) syllabus (2011) facilitators are expected to carry out a number of technical (microscopy, solubility, stain, melting point determination, refractive index measurement and density measurement tests) and non-technical (feeling, burning, and absorbency tests) methods of textiles fibre identification lessons with students; however this is not the case. Textile fibre identification and testing lessons at the Senior High School level has challenges that must be addressed to sustain the subject and make it more meaningful (Okai-Mensah *et al*., 2017). In fact it is when students skills in textile material testing and identification are well built that they will be able to make informed selection of textile products, use and care for them well.

The researcher therefore wants to find out how facilitators (teachers) teach fibre identification and testing lessons, especially the technical tests and the challenges faced during the delivery of these lessons in Senior High Schools in the Ho Municipality.

1.2 Purpose of the Study

The purpose of this study was to investigate the challenges of Clothing and Textiles teachers in textiles fibre identification and testing lessons. These challenges when identified would provide the basis for appropriate solutions, which would increase student's interest in the subject, improve student performance in the subject and invariably, likely to be translated into the overall improvement in technical education in the country.

1.3 Objectives

The following objectives guided the study:

1. Explore teaching methods used by the teachers to teach textiles fibre identification and testing lessons.
2. Identify the physical resources available for teaching textiles fibre identification and testing lessons.
3. Identify strategies that can be used to mitigate challenges in textiles fibre identification and testing lessons.

1.4 Research Questions

1. Which teaching methods are employed by teachers in teaching textile fibre identification and testing lessons?
2. What are the physical resources available for teaching textile fibre identification and testing lessons?
3. What strategies can be used to mitigate challenges faced by teachers in textiles fibre identification and testing?

1.5 Significance of the Study

i. Findings and recommendations of this study will serve as guide for teachers in their usage of appropriate textile identification and testing lesson delivery.
ii. The study will add to the store of literature in textile fibre identification and testing lessons and could be a source of reference for further studies

iii. Findings from the study could inform stakeholders and policy makers in shaping policies with regards to Clothing and Textiles education in the country.

1.6 Limitations of the study

Ideally, a study of this nature should have covered all Senior High Schools in the region as this would enable the study to have a more generalized application and stimulate further study elsewhere to confirm or dispose the findings and recommendations of this study. However due to time, funds and other logistical constraints the study could not cover a much wider area. A number of respondents were resistant in responding to the questionnaire hence a lot of time and efforts have to be put in to get the requisite responses. There were also some delays in responding to the questionnaire and the researcher spent several hours going back and forth to enable her receive the completed questionnaires.

1.7 Delimitation of the study

There are many Clothing and Textiles teachers in Volta Region, but this study was delimitated to cover those in Ho Municipality. It is however believed that the views expressed by the study participants will not substantially and significantly differ from those of the larger population of Clothing and Textiles Teachers in the entire region.

1.8 Organization of the study

The study was organized into five chapters. Chapter one focused on background to the study, statement of the problem, purpose and objective of the study, research questions, and significance of the study and delimitation of the study. Chapter two reviewed relevant related literature. Chapter three discusses the methodology which comprises research design, profile of the study area, population of the study, sample and sampling techniques and trustworthiness of questionnaire, data collection procedures, data analysis and ethical considerations. Data presentation and discussion of the research findings were made in chapter four. Chapter five finally ended the work by stating the summary of the findings, conclusion, recommendations and suggestions for further studies.

CHAPTER TWO

REVIEW OF RELATED LITERATURE

2.0 Introduction

In this study, the literature review covered theories and concepts as a theoretical undertone of fibre knowledge, classifications and testing. The review of relevant literature would cover:

i. Definition of Fibre
ii. Classification of Textile Fibres
iii. Identification of Fibres
iv. Teaching Methods and Resources
v. Educational Theories of Learning
vi. Behaviorist Theory of Learning

2.1 Definition of Fibre

Textile fibre according to Joseph (2010) is a unit; either natural or man-made which forms the basic element or building block of fabrics and other textiles structures. Wingate and Mohler (2008) noted that textile fibre is a hair-like unit or raw material of which clothes are made.

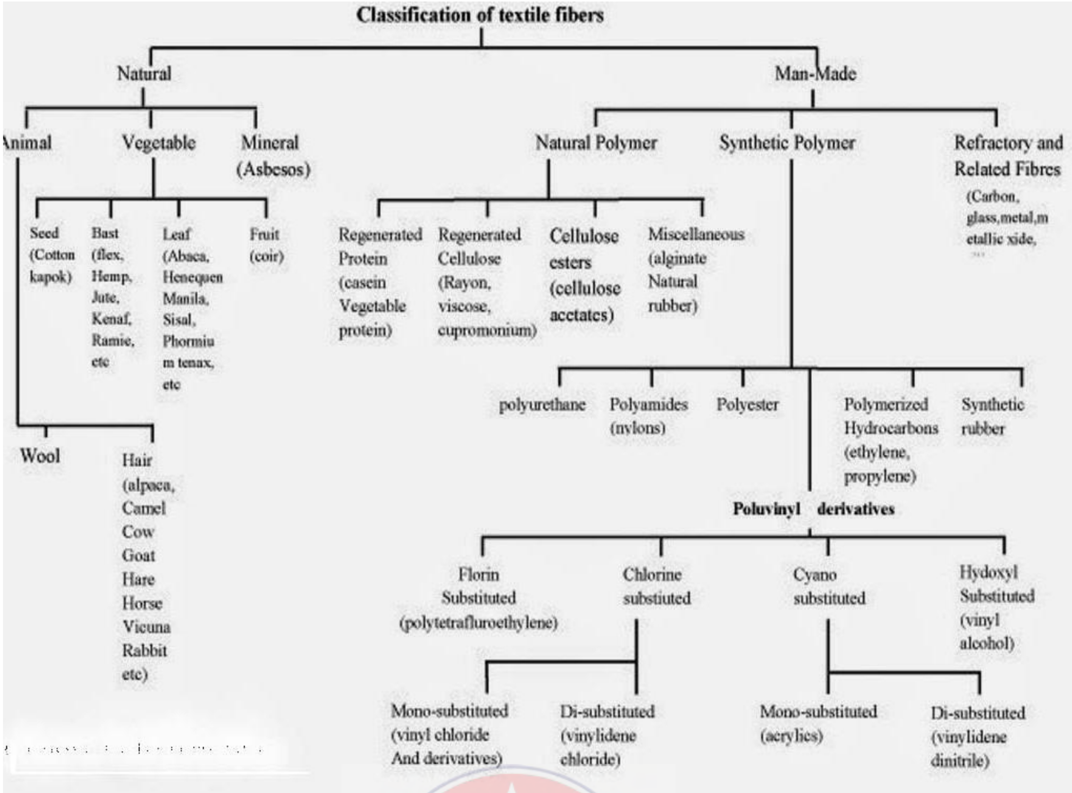
According to Hollen and Saddler (2003), textile fibre is a pliable hair-like filament that is very small in diameter in relation to its length. It is the beginning of all cloth. In another view they stated that fibre is the fundamental unit used in the making of flexible yarns and fabrics. The characteristics of the finished fabric would depend upon a number of factors. Clothing and Textiles syllabus (2003) points out fibre, as a flexible tiny hair-like structure used to produce yarn for fabric. Forster (2014), states that fibre is any substance with suitable characteristics for being processed into fabric.

Textile fibres can be classified into two main categories as natural and man-made or manufactured. Specifically, a textile fibre is characterized as having a length at least 100 times its diameter and a form that allows it to be spun into a yarn or made into a fabric by various methods. Fibres differ from each other in chemical structure, cross-sectional shape, surface contour, colour, as well as length and width (Hatch K. , 2013). The diameter of textile fibres is small, generally 0.0004 to 0.002 inch (in.), or 11–51 micrometers (μm). Their length varies from about 7/8 inches (in), or 2.2 centimeters (cm) to many miles. Based on length, fibres are classified as either filament or staple (Brunner, 2005). Filaments are a type of fibre having indefinite or extreme length, such as synthetic fibres which can be made to any length. Staple fibres are natural fibres or cut lengths of filament, typically being 1.5 to 8 in (3.75 to 20 cm) in length. The size of natural fibres is usually given as a diameter measurement in micrometers (Houck, 2009).

2.2 Classification of Textile Fibres

Fibres are classified into two major classes: natural and man-made as shown in figure 2.1. A natural fibre is any fibre that exists as such in the natural state. This includes important vegetable fibres such as cotton, jute and sisal; animal fibres, such as wool, camel and silk; and mineral fibres such as asbestos and glass.

Manufactured fibres (man-made fibre) are made by processing natural or synthetic organic polymers into a fibre-forming substance. Man-made fibres are classified into three (Freeman, 2011); those made from natural polymers (regenerated fibres), those made from synthetic polymers and those made from inorganic materials (refractory fibres).



Source: Condra (2008)

Figure 2. 1 Fibre Classification Chart

2.2.1 Vegetable or cellulosic fibres

There are three major sources from which vegetable, also known as plant fibres are derived. These include inter alia, seed hair, the stem and the leaf depending upon which source works best for a particular plant (Houck, 2009). Plant fibres are found in two principal forms: the technical fibre, used in cordage, sacks, mats, etc., or individual cells, as in fabrics or paper. The most common plant fibres encountered are cotton, flax, jute, hemp, and sisal. Bast fibres are those derived from the stems of the plant, leaf fibres from the leaves and seed fibres from in and around the reproductive pod.

2.2.1.1 Bast fibres

Flax (linen) is derived from the stem of *Linum usitatissimum*. It has a clockwise twist and may range in diameter from 40 to 80 µm. The ultimates are polygonal in cross-section, with thick walls and small lumina.

Jute (*Corchorus capsularis*) appears bundled microscopically and may have a yellowish cast. The ultimates are polygonal but angular with medium-sized lumina. It can be distinguished easily from flax by its counter-clockwise twist. The dislocations appear as angular X's or Y's and may be numerous (Freeman, 2011).

Ramie (*Boehmeria nivea*) has very long and very wide ultimates, with the width ranging from 25 up to 75 µm. The walls are thick and appear flattened in cross-section. Ramie has frequent, short dislocations and longer transverse striations. In cross-section, radial cracks may be present.

2.2.1.2 Leaf fibres

Sisal (*Agave sisilana*) is relatively easy to identify due to its irregular lumen size, acicular crystals, spiral elements and annular vessels. Sisal has a counter-clockwise twist. In cross-section, sisal looks somewhat like cut celery (Houck, 2009).

2.2.1.3 Seed fibres

Cotton has a flat twisted ribbon-like appearance made up of several spiraling layers around a central lumen. Kapok fibres are however hollow, producing very buoyant products, but are brittle, which precludes spinning or weaving.

Coir (*Coco nucifera*) comes from the husk of the coconut and accordingly, is a very dense, stiff fibre easily identified microscopically. On a slide mount, coir appears very dark brown or opaque with very large, coarse ultimates. Coir also has a distinctive cross-sectional shape (Houck, 2009).

2.2.2 Animal Fibres

Textile fibres derived from animal sources are typically the hairs of mammals (Houck, 2009). Animals produce three main types of hairs: vibrissae (whiskers), guard, and fur. Guard hairs are the relatively long, thick hairs which cover the main portion of an animal's body. Guard hairs are the most useful in identifying and comparing animal hairs. Fur hairs, by contrast, are small, thin hairs that provide bulk and warmth.

All mammalian hairs grow from follicles embedded in the skin, in contrast to the silks which are extruded from silk moth larvae. The chemical composition of all animal hairs is the same; they are made from the protein keratin, whereas silk fibres consist of the protein fibroin. This difference affords each animal fibre type different and unique properties which result in a plethora of textiles destined for a variety of end-uses (Bullio, 2000)

2.2.2.1 Animal hairs fibres

Morphologic characteristics exhibited by animal hairs are usually examined using the optical microscope, which is excellent for examining the interior of the hair shaft; however, the exterior of the hair, i.e. the cuticle, is best examined using a scanning electron microscope (SEM) as the resolution of the image is far higher than that attainable with the optical microscope, resulting in a much more detailed image (Freeman, 2011). In Senior high schools however, the available microscopes are optical hence infra-structure determination using electron microscopy would not be possible (Hatch, 2013).

2.2.2.2 Silk Fibres

Silk fibres although produced by an animal and a protein-based fibre, is not generally regarded as a true animal fibre (Tungo *et al.,* l2003), since it comprises of fibroin and not keratin, nor does it grow from a follicle embedded beneath the skin but is extruded from modified salivary glands from a larva. As such it does not bear any of the morphological characteristics exhibited by the true keratin animal fibres. Under the microscope silk has the appearance of a glass-like filament of uniform diameter which may bear striations along its length. In the raw state the colours of the fibres may reveal if the fibre has been produced as cultivated silk or as the product of wild silk; cultivated silk, once degummed, has a high natural lustre and sheen white in colour. Wild silks vary in colours such as white, cream, green, brown, and amber. The variety of colours is attributable to the variety of leaves consumed by the various wild silk.

2.2.3 Natural Mineral Fibre

Natural mineral fibres such as asbestos occur in a fibrous crystalline form. The asbestos is initially crushed to open up the fibre mass, followed by carding and spinning to yield fibres of circular cross-section 1-30 cm in length. Asbestos is very resistant to heat and burning, to acids and alkalis, and to other chemicals. Although it has low strength, asbestos fibre does not deteriorate in normal usage, and it is not attacked by insects or microorganisms. Asbestos is used in fireproof clothing, conveyor belts, brake linings, gaskets, industrial packaging, electrical windings, insulations, and soundproofing materials (Hearle, 2008).

2.2.4 Synthetic Fibres

There are many synthetic fibres i.e. organic fibres based on petrochemicals. The most common are polyester, polyamide (often called nylon), acrylic and modacrylic, polypropylene, the segmented polyurethanes which are elastic fibres known as elastanes, and speciality high-tenacity fibres such as the high performance aramids and UHMwPE (Ultra High Molecular weight PolyEthylene) (Freeman, 2011), but this literature focuses on nylon and polyester.

Synthetic fibres are formed from substances that, at any point in the manufacturing process, are not a fibre; examples are nylon, polyester and saran. No nylon or polyester fibres exist in nature and they are made of chemicals put through reactions to produce the fibre-forming substance (Kroschwitz, 2019).

2.2.4.1 Nylon

Nylon is a common name for aliphatic polyamide and is classified according to its number of constituent aliphatic carbons. However, nylon is conventionally referred to as polyamide fibre. Nylon 66 and Nylon 6 are the most common nylons, with the chemical formula $H-[HN(CH_2)_m \cdot NHCO(CH_2)_n CO]_x - OH$(nylon m, n + 2) or, $H-[HN(CH_2)_n CO]_x - OH$(nylon n + 1) which are produced by poly condensation of diamine (hexamethylene diamine) and dicarbooxylic acid (adipic acid), and by poly-condensation of ω-aminocarboxylic acid or ring-opening polymerization of lactam (ε-caprolactam), respectively (Houck, 2009).

2.2.4.2 Polyester

Polyethylene terephthalate (PET) which is the most successful synthetic fibre, is composed of ester links of aliphatic (ethylene diol) and aromatic (terephthalic acid) groups. The aromatic group is rigid and is considered as a long virtual chemical bond, so that the extended chain assumes a large zigzag form, resulting in a lower intrinsic Young's modulus (*ca*. 110 GPa) of the crystalline region in the molecular axis direction in comparison with the more extended polyethylene chain (*ca*. 280 GPa). When the aliphatic carbon number increases, the 3D structure of molecular chains then changes and the Young's modulus decreases. Indicate your sources of information (Cook, 2013).

2.2.4 Regenerated fibres

The most common regenerated fibre is viscose, which is made from the polymer cellulose obtained mostly from farmed trees. Other cellulose-based fibres are Lyocell, Modal, Acetate and Triacetate. Less common natural polymer fibres are made from rubber, alginic acid and regenerated protein.

A chemical is added to extract the cellulose fibres. The classification of the fibre relates to the chemical solvent system used to extract the fibre, so regenerated fibres are part natural and part artificial. Regenerated fibres can be filament or staple; they can be given many textures and properties like synthetic fibres (Cook, 2013).

2.2.5 Inorganic Material Fibres

The inorganic man-made fibres are fibres made from materials such as glass, metal, carbon or ceramic. These fibres are very often used to reinforce plastics to form composites.

2.3 Identification of Fibres

Identification is a process of classification or placing the fibre into groups or sets with shared characteristics (Thornton, 2006). This involves observing the physical and chemical properties of the fibres to put them into sets with successively smaller memberships. These properties can be observed by a combination of microscopy and chemical analysis. Fibre identification and testing methods occur in two principal forms, namely, non-technical and technical methods.

Nontechnical testing does not require any special equipment or setting for identification of fibre. The different non-technical methods of identifying textile fibres including feeling test, burning, and absorbency are further discussed below. Also a number of technical tests are employed in fibre identification but only the following would be discussed in detail for the purposes of this study *viz*; microscopic, solubility, stain, melting point determination, refractive index measurement and density measurement tests.

2.3.1 Feeling test

This involves touching a fabric and feeling the fabric to know its component fibres. For example, wool fabrics will feel warm when touched because the heat generated by wool, which is a non-conductor of heat, will remain in the touched area itself (Corbman, 2006). On the other hand, the fabrics made up of plant fibres such as cotton fabrics, linen fabrics and rayon, feel cool to touch. As they are conductors of heat, the heat generated by the finger passes off making the fabric to feel cold. However, it requires a long experience of handling different fabrics over a period of time to master this skill of touch. Also, it is difficult to examine and compare the fabrics made of different fibre contents with the feeling test. The feeling test can be carried out further through the inspection of Fibre Length.

Hollen and Saddler (2003) explained that visual inspection of fibre length is always the first step in fibre identification. This can be done when the yarn is removed and untwist, to get the fibre to determine the length, observe the luster, texture, body, hard-soft-to hard, warm to cool etc.

Corbman (2006) describes visual inspection as an identification which requires perception to be valuable. Skilled perception is acquired only after handling many different fabrics over a period of time.

2.3.2 Burning Test

The other non-technical test of fibre identification is the burn test; it involves burning a sample of fibres or yarns and observing the various characteristics shown by it before, during and after burning in order to determine its fibre content. The burning test relies on the fact that the chemical composition of a fibre will largely determine its behaviour when exposed to flame. The nature of contraction, smell, combustion and ash of a fibre will normally provide an indication of its generic type (Joseph, 1999).

Fibres can be identified through the smell of the smoke it gives off in burning and the ash or melted bead that remains after it has burned. One of the most distinctive odours produced by burning a sample of fibre is that of nylon, where the smell is traditionally described as being like that of 'burning celery'

According to Hollen and Saddler (2003), burning test can be used to identify the chemical composition, such as cellulose, protein, mineral or chemical and thus identifies the group of which the fibre belongs. If visual inspection is used along with the burning test, fibre identification can be carried further. For example, if the sample is cellulose and also filament, it is rayon; but if it is staple, a positive identification cannot be made. For excellent burning test Hollen and Saddler (2003) gain suggested the following:

i. Ravel out and test several yarns from each side of the fibre to see if they have the same fibre content. Difference in luster, twist and colour will indicate that there might be two or more kinds of fibre in the fabric.
ii. Hold the yarn horizontally. Use tweezers if desired. Feed the yarns slowly into the edge of the flame and observe what happens. Repeat this several times to check results.

Corbman (2006) wrote that to recognize the composition of fabrics by the burning test, the sample of fibre, yarn or fabric should be moved slowly towards a small flame and the reaction to the heat carefully observed. The latter author indicated that if both the lengthwise and the crosswise yarns in a fabric are known to be the same substance, the sample may be tested as a whole.

Evans-Solomon and Opoku-Asare (2001) stated that more than one kind of yarn, however is sometimes used in fabrics. When the presence of different yarns is suspected, the lengthwise yarns should be separated from the crosswise yarns and each set should be tested separately. When it is believed that more than one fibre has been blended into a single yarn, the yarn should be untwisted and with the aid of the magnifying glass and tweezers, the individual fibres separated.

Admittedly, burning test is quite reliable and simple to be carried out by any individual who can perform the test satisfactorily for a better result. Gay (1996) noted that burning test is of great value as it gives much useful information. Fibre should be advanced slowly towards a small careful controlled flame and finally into it. During this operation the behaviour of the fibre should be accurately noted and recorded; whether they melt and form a bead that shrinks from the flame whether they burn and beads are formed on the ends of the burnt fibres. Some fibres such as nylon shrink from flame only if a fine stand is used. Others, for example the regenerated cellulose fibre will not melt under any circumstances and consequently no bead is formed.

In general all fibres either burn and must be put out; or burn until there is nothing to burn; or they burn and they go out on their own after a few seconds, leaving remaining unburned fibre and are therefore self-extinguishing; or the fibres do not burn even with a flame held directly to it. To identify a fibre therefore watch it whiles it burns, does it go out on its own? If so it is self-extinguishing. Does it defy all attempts to burn it? Then it does not burn. Further breakdown that help identify fibres are the smell of the smoke it gives off in burning, and the ash or melted bead that remains after it has burn (Ditzy Prints, 2012). The following burning techniques were stated by the textile institute:

i. Use small ignition tool
ii. Heat fire on a piece of platinum foil above a small flame. Under these conditions, the characteristics and odours evolved from the various fibre type can be detected
iii. Any ashes remaining after ignition can then be subjected to qualitative analysis to decide if a delusting agent is present, the most frequently used being titanium dioxide.

Table 2.1 Shows burning behaviour of different fibres

Burning Behaviour of Different Fibres Fibre	Approaching	Stationary	Withdrawing	Odor	Residue
Cotton	Ignites at first	Burns rapidly	Smolders glows smokes	Burning papers or leaves	Soft gray not much
Linen	Ignite quickly	Burns rapidly	Burns actively	Burning paper	Soft gray, fine
Wool	Draws away from flame	Melts, Burns	Self-extinguishing	Burned feathers or hair	Crushable brittle black
Silk	Draws away from flame	Melts, Burns	Self-extinguishing	Burned feathers or hair	Crushable brittle black
Rayon	Ignites in contact	Burns	Burns slowly	Burning paper	Little or no ash
Acetate	Melts before contact	Melts burns with yellow Flame	Melts	Burning paper and vinegar	Hard dark bead

Nylon	Draws away and Melts	Melts, burn and Drips	Burns with Difficulty	Celery	Hard bead cream colour or dark
Polyester	Melts before contact	Melts burns black smoke	Burns for a while ; self-extinguishing	Sweet chemicals	Hard bead cream colour or dark
Acrylic	Melts burns before reaching flames	Melts burn	Sputters, burns	Boiled fish	Hard irregular bead,

Source: Anderson (2012).

Burning tests remain subjective, and are essentially non-reproducible. There is the added hazard that toxic fumes may be generated in such tests (e.g., with acrylic fibres).

2.3.3 Absorbency Test

Hollen and Saddler (2003) explained absorbency test as the percentage of moisture a fibre will absorb under standard conditions of temperature and moisture. Gohl and Martin (2004) assert that absorbency test is the fibre's ability to absorb moisture or the ability of its polymer system to take up or attract water molecules and each fibre differs in its absorbency rate.

Procedures for Absorbency Test

i. Cut fabric of equal size.

ii. Pour water in small containers of the same size

iii. Immerse the fabrics you want to test for and observe their absorbency rate. Doing this in a calibrated test-tube makes it easier.

2.3.4 Microscopic Test

Microscopic test is a technical test that involves identifying the fabric with the help of a microscope with a minimum magnification power of 100. The test can easily distinguish between fibres and can identify natural fibres more easily as compared to man-made ones. Positive identification of most of the natural fibres can be made by using a light microscope. Synthetic fibres are very similar in appearance and the increase in the number of varieties makes it a little tough to distinguish the fibres under a microscope (Martin, 2004), Berland (2014) therefore suggested the use of a polarizing microscope for identifying synthetic fibres. Also for synthetic fibres a cross-section appearance is helpful if more careful examination is desired.

The microscope is the primary tool for fibre analysis and the applications range from simple stereomicroscopy through higher power optical and polarizing microscopy to scanning electron microscopy. Instrumentation routinely has integrated microscopes to analyze small samples. Despite the power of modern computerized instrumentation, microscopy should always come first. Low and high-power optical microscopy is the most commonly employed of all of the microscopic techniques. It is also the most discriminating method because most textile fibres can be excluded from a known sample by size, shape, colour, or some other easily observable microscopic characteristic. Stereo microscopes, polarized light microscopes, comparison microscopes, and fluorescent light microscopes are all used in the identification of fibres as well as in comparison of known and questioned fibres.

A polarized light microscope is a central tool for the identification and analysis of manufactured fibres. Many characteristics of manufactured fibres can be viewed in non-polarized light, however, and these provide a fast, direct and accurate method for the discrimination of similar fibres. Given proper training and experience, a fibre examiner can identify a fibre's generic class simply by its microscopic characteristics and optical properties. Refractive index and birefringence are the two most distinguishing features for the identification of a fibre's generic class (Fig. 2.2). A comparison light microscope is required to confirm whether the known and the questioned fibres truly present the same microscopic characteristics.

The cross-section is the shape of an individual fibre when cut at a right angle to its long axis. The shapes of manufactured fibres vary with the desired end result, such as the fibre's soil hiding ability or a silky or coarse feel to the final fabric. Some fibre types tend to stay within certain cross-sectional families, for example acrylics tend to appear as bean-shaped fibres and rayon tends to be irregular (Markham, 2011).

Another important microscopic technique is thermal microscopy, which can be accomplished conveniently using a commercial hot stage. In this apparatus, a computer-controlled hot stage is mounted on the stage of the microscope. A very small piece of the fibre is then placed on a special slide and inserted into the hot stage. The melting point range can be observed and recorded. This technique can be used to distinguish between certain subclasses of synthetic fibres that differ only in polymer structure, such as some nylons and polyesters (Martin, 2004).

2.3.4.1 Fluorescence microscopy

Certain organic materials display the phenomenon of 'fluorescence'. This is a process in which light of one characteristic wavelength (and hence colour) is emitted following excitation of the molecule by light of another, shorter, wavelength. It is quite commonly observed in biological systems, where it can give rise to a very reliable means of identification. The same can hold true for textile fibres. It may be that the constituent polymer itself contains one or more fluorescent species or that there are certain additives within the fibre (including dyes and pigments) fluoresce. A fluorescence microscope makes use of this emitted light, from which an image of the fibre, or part thereof, is formed.

The wavelength of the light stimulating fluorescence varies from one molecular species to another, as does the fluorescence itself. Thus, a given species will fluoresce with a characteristic colour, provided light of the appropriate wavelength is used to stimulate it. In the most basic system, the illumination source is a bright white light; a set of filters and a dichroic beam-splitter is then used to ensure that only the excitation wavelength reaches the specimen, and that only the expected fluorescence colour reaches the observer (or detector) Indicate your source of information (Lindley, 2008).

2.3.4.2 Confocal microscopy

Ideally, an optical microscope image should be formed exclusively from light originating from the plane within the specimen upon which the object is focused. Inevitably, however, stray light arising from out-of-focus regions will also reach the eye (or, more generally, detector). This produces blurring of the image and, in consequence, degradation of the information obtained. It can be particularly severe in fluorescence microscopy, where the whole specimen may be contributing to the fluorescent effect. Confocal microscopy was developed in order to eliminate this problem (Lindley, 2008).

2.3.4.3 X-sectional and Longitudinal View of Different Fibres

The knowledge of fibre identification obtained by seeing the fibre under the microscope and observing some of the differences among fibres in each group is of help in understanding fibre and fabric behaviour. In the following images below longitudinal and cross-section views have been shown for common natural and man- made fibres.

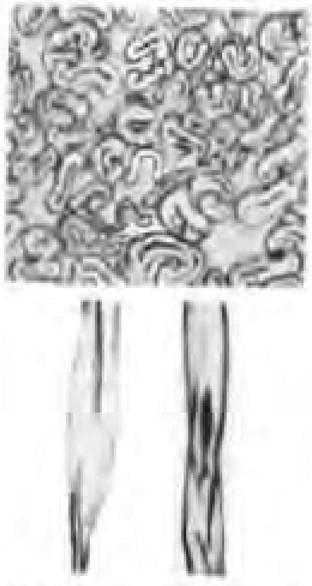


Fig.1 Cotton, not mercerized

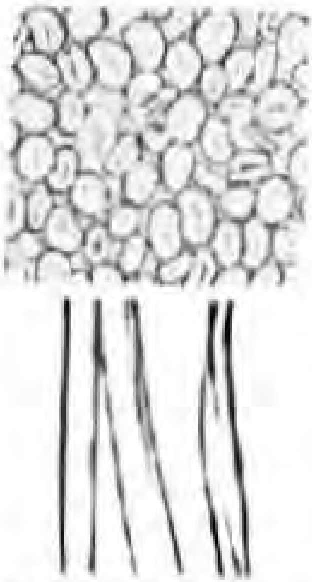


Fig. 2 Cotton, Mercerized

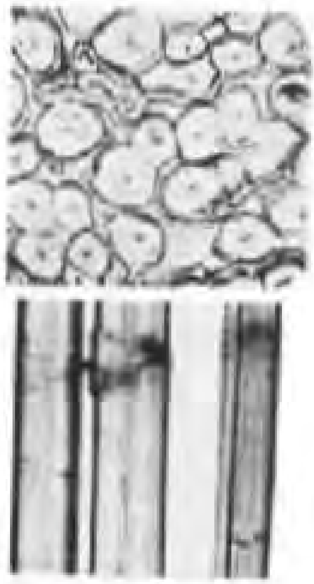


Fig. 3 Flax

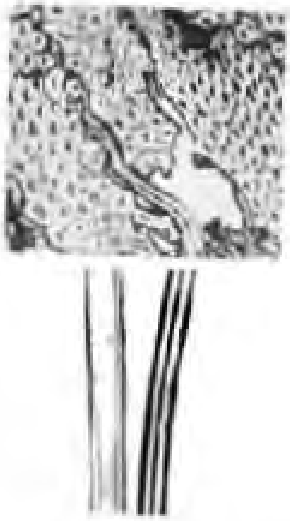


Fig. 10 [illegible]

Fig. 11 Wool

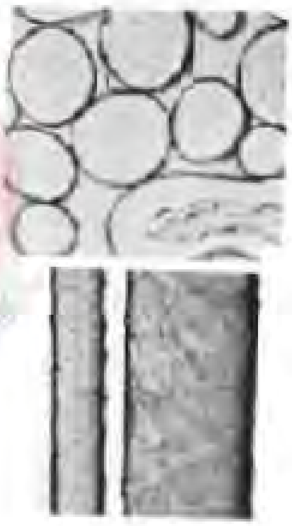


Fig. 12 [illegible]

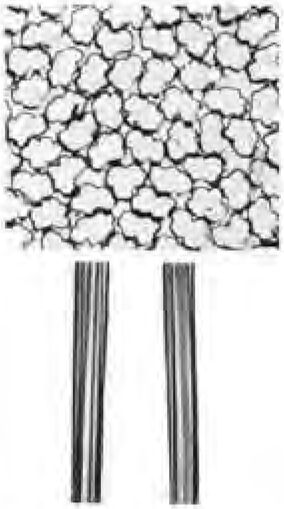


Fig 13 Acetate, Secondary

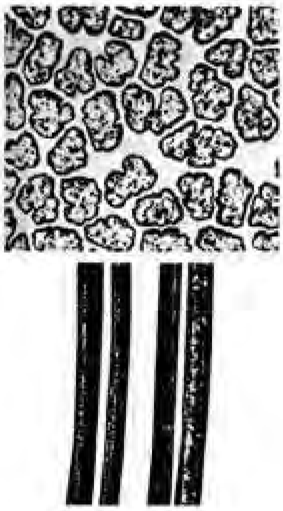


Fig. 14 Triacetate 2.5 Den, dull luster

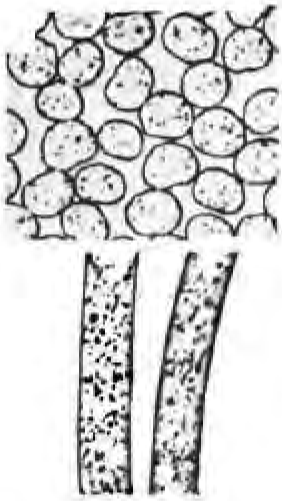


Fig. 15 Acrylic, Reg. wet spun, Semi dull

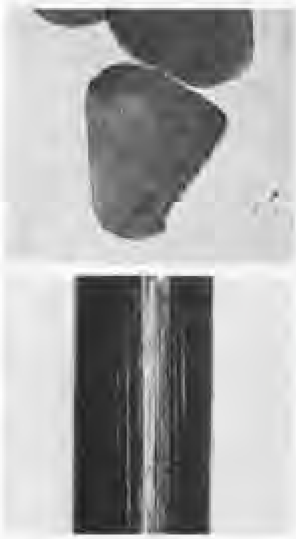


Fig. 19 Polyethylene medium density

Fig. 20 Polyethylene, high density

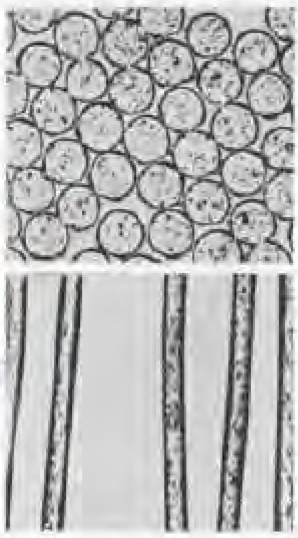
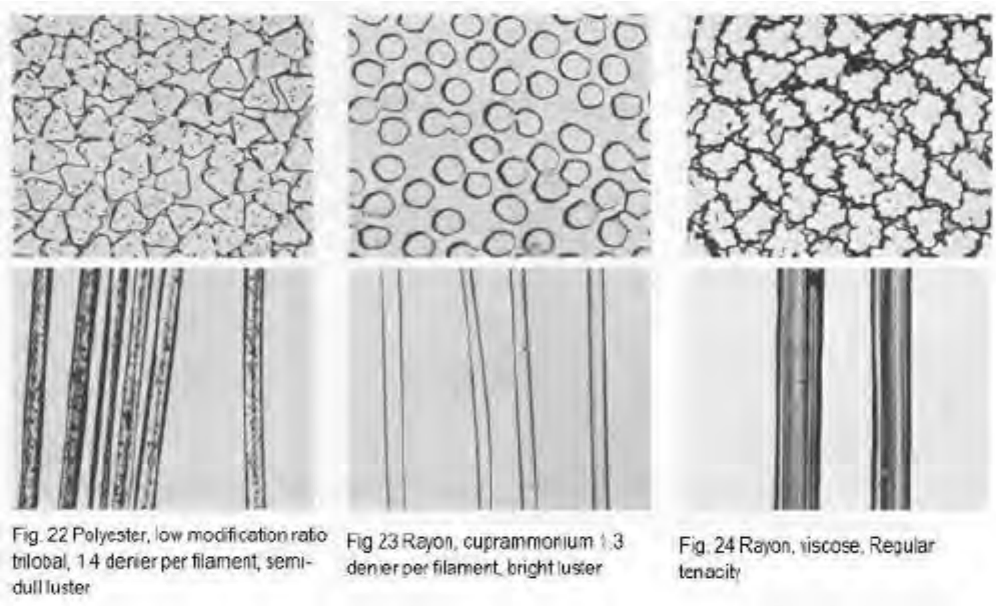


Fig 21 Polyester, Regular melt spun, 3.0 denier per filament, semi dull



Source: Anderson (2012)

Figure 2.2 Longitudinal and cross-section views of some common natural and man-made fibres

2.3.4.4 Procedure for Microscopic Examination of Fibres

The following directions for using the microscope have been given by Hollen and Saddler (2003):

i. Clean the lens, slide and cover glass
ii. Place a drop of water on the slide
iii. Untwist a yarn and place the loosened fibre on the slide. Cover with the cover glass and press down to eliminate air bubbles
iv. Place the slide on the stage of the microscope and then focus with low power first. Make sure you focus on a single fibre.
v. If a fabric contains more than one fibre, test each. Be sure to check both the warp and weft (filling yarns).

Better results are obtained when a single fibre is observed under the microscope. According to Joseph (1999), fibres are mounted to provide views of both their lengthwise and crosswise dimensions. Berland (2014) indicated that three types of microscopic preparation may be required for examination of fibres; whole mounts, cross section and cast, each of these should be considered separately. The first examination of a sample of unknown fibre should be by means of a longitudinal view of the fibre in whole mount.

For effective microscopic identification, the textile institute gave the following characteristics to be observed

i. Scale margins – indicating animal fibre
ii. Convolution, lumen and reversal zone indicating cotton.
iii. Bundles of fibres with or without cross-making indicating bast and leaf fibres
iv. Smooth profile without scales or convolution, with or without striations (stripped pattern) indicating man-made fibre or silk.
v. Flat, ribbon-like profile indicating metallic yarn or spilt film fibres

According to Cabman (2006), knowing how a fibre looks like under the microscope helps to understand other identification test. A very dark coloured fibre cannot be identified under the microscope because light which is necessary for identification cannot pass through dark substances. Such a fibre needs to be bleached to determine the correct composition of the fibre.

2.3.5. Solubility Test

An indication of the chemical composition of a fibre can be readily gained by establishing in which solvent it dissolves. This can be achieved by immersing fibres in a prescribed series of solvents, usually of ascending chemical reactivity, until the first is found in which it dissolves. Confirmatory tests may then be carried out using solvents of known behaviour for the initially identified fibre type. A fresh specimen must be used for each solubility determination, to avoid any risk of cumulative damage effects.

Hollen and Saddler (2003) noted that solubility tests are used to identify man-made fibres by generic class and to confirm identification of natural fibres. Joseph (1999) also explained that the solubility of a fibre in a specific chemical is a definite means of specific fibre identification. However, this process identifies only generic groups or categories. If students carry out chemical solubility test accurately, it is possible in many cases to positively identify specific fibres. In addition to aiding in fibre identification, familiarity with fibre behaviour in various chemicals provides helpful information concerning the processing and care of textile fibres.

Additionally, Joseph (1999) stated that for effective result of chemical solubility test the following procedures must be carefully carried out:

i. Use the same sample of yarn or fabric until the total subtracts has been destroyed or put through every test.
ii. Place the sample in the first reagent listed at the recommended temperature and leave the sample in the chemical for five (5) minutes before continuing.
iii. Remove any fabric that is left and rinse carefully in water.
iv. Observe the fabric to determine whether some fibres have been dissolved or altered in anyway.
v. In some cases, it may be helpful to look at the remaining fibres under the microscope to determine whether they have been damaged
vi. Record the result of each step carefully.
vii. Place the remaining fibres in solution two (2) and repeat the test.
viii. Continue this procedure until all of the samples have been dissolved.

Table 2. 2 Examples of commonly applied solvents in solubility tests

Fibre type	Soluble in	Insoluble in
Nylon	80% Formic acid	Xylene
Acrylic	Boiling dimethyl formamide	80% Formic acid
Viscose/Modal/Lyocell	Cuprammonium hydroxide	Xylene, 80% formic acid
Polyester	Dichloroacetic acid	Xylene, 80% formic acid, dimethyl formamide
Polyolefins	Boiling xylene	Cuprammonium hydroxide, 80% formic acid

Source: Brunner (2005)

2.3.6 Stain Test

The stain test is also known as the Double Barrel Fibre Identification (DBFI), the test is based on the theory that each fibre has its own distinct two- colour reaction when treated with stain. A fibre will turn to a particular colour in the presence of dilute acetic acid and to some other specific colour when stained in the presence of a mild alkali (Corbman, 2006).

The different chemical composition and reactivity of different fibre types cause them to have particular affinities for specific dye or stain types. This has led to the development of mixture of dyes which are specifically prepared as fibre identification stains, and which produce known colours for individual fibre types. A further refinement is the compilation of stain mixtures for distinguishing variants of the same fibre type, e.g. acrylics, of which Meldrum's Stain (Lindley, 2008) is an example.

The chief limitation of staining tests is that they can only be used on undyed material, and chemical damage may also affect the nature of staining. Nevertheless staining tests can be very useful – particularly if combined with light microscopical examinations.

2.3.7 Melting point determination

The thermoplastic nature of many chemical (synthetic) fibres causes them to soften and shrink on the application of heat. The temperature at which these changes occur can provide a useful diagnostic feature of the fibre type. Even where true melting does not take place, the test can serve to eliminate certain fibre types. Instruments specifically designed for determining the melting point of fibres or plastics are available, or the test may be carried out under the light microscope using a specially adapted hot stage. As with the solubility tests this latter method permits positive recognition of different component fibres in a blend (Wildman, 2009).

Table 2. 3 Melting points of selected common manufactured fibres

Fibre type	Melting point (°C)
Acrylic	Does not melt but decomposes with discolouration
Aramid	Does not melt
Cellulose diacetate	250–255
Cellulose triacetate	290–300
Chlorofibre	185–210
Modacrylic	Does not melt but decomposes with discolouration
Nylon 6	210–216
Nylon 6.6	252–260
Polyester	250–260
Polyethylene	133
Polypropylene	160–165

Source: Brunner (2005)

2.3.8 Refractive index measurements

The molecular structure of textile fibres makes them optically anisotropic, i.e. they have two refractive indices – one for light polarised along the fibre's axis and one for light polarised across it. The fibres are thus said to be birefringent. For colourless (undyed) fibres, the refractive index for each direction may be found by simply mounting the fibre in different liquids of known refractive index until the two are found which causes the fibre to become invisible for light polarised along the fibre axis, and for light polarised across it (normally referred to as 'parallel' and 'perpendicular'). The difference between these values is the birefringence of the fibre, and constitutes a distinct identification feature. While the most accurate method of determining the refractive index of a fibre is to use monochromatic light and an interference microscope, it is quite possible to achieve satisfactory results with white light and a rotatable polarizing filter attached to an ordinary light microscope. The accuracy with which polarised light microscopy may be used to identify fibres has been documented by Carroll (2002).

2.3.9 Density measurements

The polymers of which fibres are made have different densities and this can be used as a diagnostic test. Values may range from below 1.0 g/cm3 for polyolefins to over 2.5 g/cm3 for glass fibres. In its simplest form, a density gradient column is made which consists of a vessel of liquid having a near linear density increase from the top to the bottom of the column. Ethanol/water mixtures or varying strengths of salt solutions are examples of possible liquids.

It is vital that any medium does not cause absorption or swelling to the fibre under test as this will result in a change of density. Fibres of known density are placed in the column and allowed to reach their stable positions in the liquid, i.e. where the density of the fibre matches that of the liquid. The test fibre is introduced into the system and the point at which the sample stops sinking is taken as the point of equivalent density.

Variants of the density gradient technique are titrimetric methods, where the volume of liquid adjusting the density is metered through a burette and the 'end point' of no movement of the sample is recorded, centrifugally accelerated determinations and kinetic (rate of fall) measurements. With all density based determinations, accurate control of temperature must be ensured (Cohen, 2015).

2.4 Teaching Methods and Materials

To teach is to impact knowledge, an attempt to help the learner have a change of attitude and acquire skills through a series of planned activities (Black, 2010).Teaching methods are the various strategies a teacher or facilitator employs to deliver her subject matter to learners based on the instructional objectives to bring about learning. Teaching methods aid learning and help to communicate ideas and skills to the students. Several teaching methods exits for use in the classroom, it is therefore imperative for the teacher to use the ones most appropriate for the lesson. These methods if properly used will enhance teaching and learning and bring about the desired changes, or the learning outcomes in students.

Kassem (2012) defined teaching techniques as "teacher's activities in the class to involve students in the subject matter", and requires that students participate in learning activities, share equally with other learners, and react to the learning experience. The teacher also needs to work with students as a friend, make the learning place more comfortable, organize his/her lesson plans, and influence students by using different teaching methods. The teaching goals must be adapted to the needs and interests of learners, while teaching strategies should be carefully used to improve learning and make the subject matter useful.

Learning aids or materials are devices or mechanisms designed to make learning more effective, efficient, and satisfying, while simplifying and organizing complex content and connecting new ideas to old ones (Yelon, 1996). Yelon further explained that they are built to focus the learners' attention on what is being taught, ease learning, produce recall, foster transfer and speed instruction.

The learner's power to think and solve problems should be a component of a well-designed instructional strategy and its effectiveness. The teaching-learning process in secondary education is basically a problem solving activity. According to Dyer and Osborn (2009), the learner's problem solving ability can be accelerated with the use of appropriate instructional materials and approaches. Clothing and Textile education programmes provide a curriculum aimed at helping individuals gain knowledge and skills in the subject. Moore (2004) studied the historical teaching methodologies in textile education and found three major teaching approaches in Clothing and Textiles: formal steps, project approach, and problem solving approach.

Newcomb *et al*. (2000) and Tyler (2000) concluded that the teaching strategy must base learning on inquiry, investigation, and critical study in situations in which genuine purposes, needs, and wants are experienced. For this reason, the role of teachers and their teaching strategies are never ending topics in all educational settings (Miller & Connors, 2006)

Recently there has been much concern expressed about the quality of teaching in educational institutions, while industries in the rapidly changing society have been concerned about the well educated person. These concerns have led to the issue of teaching strategies and their effectiveness in SHS Clothing and Textile education (Kahler, 2005; Moore, 2004). As Clothing and Textile educators it is the responsibility of teachers to ensure adequate teaching and learning as necessary to meet the changing needs of the industry and the values of society (Melion, 2005). To Carkhuff (2009), teaching is the opportunity to help others to live their lives fully, which means teachers help to give to learners' lives through their physical, emotional, intellectual and social growth. Anderson (2012) concluded that student outcomes may heavily depend on the teacher's instructional planning, teaching method selection, and having a variety of learning activities.

Students come from different backgrounds and have varied experiences and abilities.

Good teaching is not only dependent on teaching strategies or their effectiveness but it also depends on individual needs and adequacy of the content. Dyer and Osborne (2009) proposed that "the selection of an appropriate teaching approach is one of the most important processes to have teaching success and student achievement" (p. 260). Dyer and Osborne (2009) further stated that "students react differently to different teaching methods, and that the selection of the proper method is critical to the learning style of those being served by the instruction" (p. 260). There is an assumption that students learn with different styles, at different speeds, different levels of prior knowledge and different environments when the subject matter is given by way of a variety of teaching strategies.

It is important to note that the literature states that students learn and achieve when competent teachers use well organized instructional strategies, a variety of methods and tools, and use them effectively. Martin (1995) stated that Textile Education is the scientific study and appropriate application of the principles and methods of teaching and learning as they pertain to the food, fibre and natural resource system.

Boyatzis (2005) in discussing types of teaching methods explained that teaching methods could be presented under three main categories:

i. Cognitive development methods

ii. Affective development methods

iii. Psychomotor development methods

2.5.1 Cognitive Development Methods

Here, if the focus of the instructional objectives is to develop intellectual skills in learners, then the cognitive development methods of teaching are recommended. This method helps learners to comprehend, analyse, synthesize and evaluate information. It helps learners develop good cognitive abilities though the cognitive development methods are essentially didactic (Macmillan, 1997). Some of the teaching methods in this category include:

i. Discussion Method

ii. Questioning/Socratic Method

iii. Team Teaching Method

iv. Talk Chalk/Recitation Method

v. Field Trip/Excursion method

2.5.2 Affective Development Method

This domain includes objectives which describe changes in interest, attitudes and values. It further deals with the development of appreciation and adequate adjustment. Education has a lot to give the learner in order to assist him/her develop in these areas. Hence, teachers are encouraged to include learning experiences that are worthwhile, teach in ways that arouse interest and develop proper attitude in learners (Kassem, 2012). This mode of teaching are basically philetic, here students feelings or opinion are aroused. Some teaching methods under this category include:

i. Modelling Method

ii. Simulation Method
iii. Dramatic Method
iv. Simulation Games
v. Role-Playing Method

2.5.3. Psychomotor Development Methods

These are activity based methods of teaching that aim at motor skills development in learners. This method requires that learners are able to illustrate, demonstrate, or perform certain skills using their manual dexterity. It is a heuristic method of teaching that involves inquiry and discovery methods of teaching (Yelon, 2016). It is a more student activity based method. This method includes:

i. Inquiry Method
ii. Discovery Method
iii. Process Approach Method
iv. Demonstration Method
v. Laboratory/Experimentation Method
vi. Programmed Learning Method
vii. Dalton Plan/Assignment Method
viii. Project Method
ix. Microteaching Method
x. Mastery Learning

Though there are several methods of teaching, the following methods will be discussed as they are relevant to the teaching of textile fibre identification.

1. Demonstration Method

2. Inquiry/Discovery Method
3. Project Method

2.5.3.1 Demonstration Method

A demonstration involves showing, doing or telling the students the point of emphasis. It is mostly used as a technique within a method of teaching and at times as a method of teaching itself. Here the role of the teacher is to illustrate how to do something or illustrate a principle first by explaining the nature of the act verbally, followed by demonstrating the act in a systematic manner and later the students repeats the act. Here students are involved in doing things that will influence their behaviour patterns, through demonstrations, students are exposed to physical materials that will illustrate some meaning to their cognitive framework. Direct experiences like this go a long way to enrich learning. Demonstration is useful mostly in imparting psychomotor skills and lessons that require practical knowledge. The gains of using demonstration method in teaching lies in the fact that it bridges the gap between theory and practice, enables learners to become good observers and generate their interest; students see immediate progress as a result of a correct effort and it enables the teacher to teach manipulative and operational skills (Swan, 2005). The problems encountered in this method amongst others include the fact that students loose interest and confidence when they fail to repeat accurately; creativity and originality by students are hindered as students try to do it exactly the same way as their teacher did it and students have a limited opportunity to be familiar with learning materials.

2.5.3.2 Inquiry/Discovery Method

This is a teaching learning situation whereby students are given the opportunity to discover and find out things for themselves. Inquiry/discovery methods have been known to provide meaningful learning to students when compared to other methods.

This method is rooted in the heuristic teaching activity and problem solving; these are basically the major ingredients of modern science. It is a learner centered method, whereby the learner discovers and explores some problem solving experiences with a view to draw conclusions from data gathered through the process of observing, predicting, measuring and formulating relevant questions. Learning acquired through inquiry/discovery method is mostly accepted as more meaningful and authentic than learning imposed by external forces. This method can be used with students at any academic level though more effective with students at the secondary and tertiary levels.

Two types of discovery methods can be used by the teacher namely the structured method and the open discovery method.

Structured Method:

The teacher gives a clear set of instructions that learners are to follow to discover a fact, an idea or a skill for themselves.

Open Discovery Method:

The teacher in this method presents a problem, gives some questions and directions that requires learners to find answers to. Here, the teacher gives the learner the freedom to explore different perspectives, views, possibilities, and solutions to the problem (Swan, 2005).

There are no stereo type answers as the learners arrive at different solutions to a problem, especially in the case of the open discovery method. In both situations, they are expected to find the solution within a specific time frame ((Swan, 2005).

The gains of inquiry/discovery methods:

i. demonstrate student's proficiency

ii. encourage curiosity

iii. encourage students to develop coding system which helps them to make connection among objects and phenomena.

iv. foster intuitive thinking in the classroom

v. develop good communication skills as science requires distinct communication for accurate sharing of methods and findings and

vi. finally, students become independent thinkers.

2.5.3.3 Project Method

Project Method or Project-based learning (PBL) is a student-centered pedagogy that involves a dynamic classroom approach in which it is believed that students acquire a deeper knowledge through active exploration of real-world challenges and problems (Lex, 2019). Students learn about a subject by working for an extended period of time to investigate and respond to a complex question, challenge, or problem. PBL contrasts with paper-based, rote memorization, or teacher-led instruction that presents established facts or portrays a smooth path to knowledge by instead posing questions, problems or scenarios ((Worsham & Stockton, 1996).

Moore (2004) describes project-based learning (PBL) as integrating knowing and doing. Students learn knowledge and elements of the core curriculum, but also apply what they know to solve authentic problems and produce results that matter. PBL students take advantage of digital tools to produce high quality, collaborative products. PBL refocuses education on the student, not the curriculum—a shift mandated by the global world, which rewards intangible assets such as drive, passion, creativity, empathy, and resiliency. These cannot be taught out of a textbook, but must be activated through experience (Monk & Dillion, 2005). Anderson (2012) elaborate on the processes of PBL: Project-based learning is a comprehensive perspective focused on teaching by engaging students in investigation. Within this framework, students pursue solutions to nontrivial problems by asking and refining questions, debating ideas, making predictions, designing plans and/or experiments, collecting and analyzing data, drawing conclusions, communicating their ideas and findings to others, asking new questions, and creating artifacts. The basis of PBL lies in the authenticity or real-life application of the research. Students working as a team are given a "driving question" to respond to or answer, then directed to create an artifact (or artifacts) to present their gained knowledge. Artifacts may include a variety of media such as writings, art, drawings, three-dimensional representations, videos, photography, or technology-based presentations (Education World, 2013).

Proponents of project-based learning cite numerous benefits to the implementation of its strategies in the classroom – including a greater depth of understanding of concepts, broader knowledge base, improved communication and interpersonal/social skills, enhanced leadership skills, increased creativity, and improved writing skills. Another definition of project-based learning includes a type of instruction, where students work together to solve real-world problems in their schools and communities. Successful problem-solving often requires students to draw on lessons from several disciplines and apply them in a very practical way. The promise of seeing a very real impact becomes the motivation for learning (Education World, 2013; Kahler, 2005).

John Dewey initially promoted the idea of "learning by doing". In My Pedagogical Creed (1897), Dewey enumerated his beliefs regarding education:

> "The teacher is not in the school to impose certain ideas or to form certain habits in the child, but is there as a member of the community to select the influences

which shall affect the child and to assist him in properly responding to these...I believe, therefore, in the so-called expressive or constructive activities as the center of correlation"(Dewey, 1897: p23).

Educational research has advanced this idea of teaching and learning into a methodology known as project-based learning. Hunt (1999) posit that research has demonstrated that students in project-based learning classrooms get higher scores than students in traditional classroom.

2.6 Educational Theories of Learning

2.6.1 Experientialist theory

Experiential learning theory draws on the work of prominent 20th century scholars who gave experience a central role in their theories of human learning and development—notably John Dewey, Kurt Lewin, Jean Piaget, William James, Carl Jung, Paulo Freire, Carl Rogers and others—to develop a holistic model of the experiential learning process and a multilinear model of adult development (Kolb, 1984). The theory is built on six propositions that are shared by these scholars.

1. Learning is best conceived as a process, not in terms of outcomes. To improve learning in SHS education, the primary focus should be on engaging students in a process that best enhances their learning—a process that includes feedback on the effectiveness of their learning efforts. As Dewey notes, "[E]ducation must be conceived as a continuing reconstruction of experience: . . . the process and goal of education are one and the same thing" (Dewey 1897).

2. All learning is *re*learning. Learning is best facilitated by a process that draws out the students' beliefs and ideas about a topic so that they can be examined, tested, and integrated with new, more refined ideas.

3. Learning requires the resolution of conflicts between dialectically opposed modes of adaptation to the world. Conflict, differences, and disagreement are what drive the learning process. In the process of learning one is called upon to move back and forth between opposing modes of reflection and action and feeling and thinking.

4. Learning is a holistic process of adaptation to the world. Not just the result of cognition, learning involves the integrated functioning of the total person— thinking, feeling, perceiving, and behaving.

5. Learning results from synergetic transactions between the person and the environment. In Piaget's terms, learning occurs through equilibration of the dialectic processes of assimilating new experiences into existing concepts and accommodating existing concepts to new experience.

6. Learning is the process of creating knowledge. Experiential learning theory (ELT) proposes a constructivist theory of learning where by social knowledge is created and recreated in the personal knowledge of the learner.

This stands in contrast to the "transmission" model on which much current educational practice is based, where pre-existing fixed ideas are transmitted to the learner. ELT defines learning as the process whereby knowledge is created through the transformation of experience. Knowledge results from the combination of grasping and transforming experience (Kolb, 1984). The ELT model portrays two dialectically related modes of grasping experience— Concrete Experience (CE) and Abstract Conceptualization (AC)—and two dialectically related modes of transforming experience—Reflective Observation (RO) and Active Experimentation (AE).

Experiential learning is a process of constructing knowledge that involves a creative tension among the four learning modes that is responsive to contextual demands. This process is portrayed as an idealized learning cycle or spiral where the learner "touches all the bases" Figure 2.3—experiencing, reflecting, thinking, and acting—in a recursive process that is responsive to the learning situation and what is being learned. Immediate or concrete experiences are the basis for observations and reflections. These reflections are assimilated and distilled into abstract concepts from which new implications for action can be drawn.

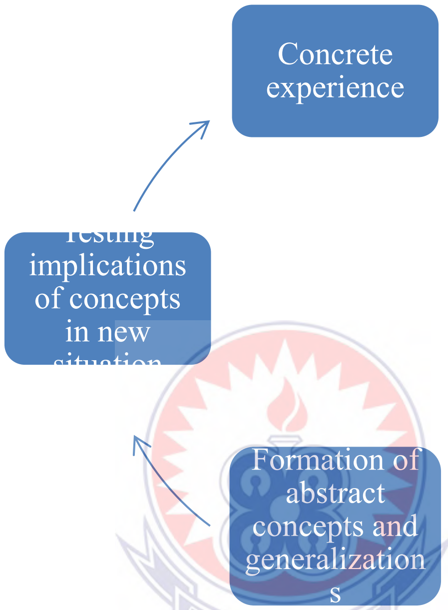


Figure 2. 3 Illustration of the experiential learning process

These implications can be *actively tested* and serve as guides in creating new experiences. In *The Art of Changing the Brain: Enriching Teaching by Exploring the Biology of Learning,* James Zull, a biologist and founding director of CWRU's University Center for Innovation in Teaching and Education (UCITE), sees a link between ELT and neuroscience research, suggesting that this process of experiential learning is related to the process of brain functioning.

Since fibre identification lessons are practically oriented, it is important to adopt the experiential learning theory to enhance student in depth understanding of the topic.

Learning is seen as a dynamic process, which leads to action: in other words, to be meaningful, learning needs to be tested in reality.

Dewey's rationale is not one which puts the educator (teacher) at the center of the process, but one that places the learner at the center. Dewey described this as: a change or revolution not unlike that introduced by Copernicus (Dewey, 1897). This is a direct shift from a situation where the focus is on the teacher, the textbook, anywhere and everywhere you please except in the immediate instincts and activities of the child himself' (*ibid*). Dewey argued that the 'center of gravity' needs to shift whereby the learner is at the center (*ibid*). Dewey is often therefore referred to as a child-centered educationalist ((Hunt, 1999) and at times it is easy to see why this conclusion is arrived at. Dewey himself suggested that the starting point should be, in his terms, the 'internal conditions': 'the child's own instincts and powers furnish the material and give the starting point for all education' (Dewey, 1897). However whilst it is clearly the case that Dewey was child centered, in the sense that he requires the educator to take due regard of the desires, interests and inclinations of the learner, this can be overstated. Education, for Dewey, was not 'laissez faire' and at the whim of the individual, or an unregulated permissiveness ((Hunt, 1999).

2.6.2 Behaviorist Theory of Learning

Behaviorism is a learning theory that only focuses on objectively observable behaviours and discounts any independent activities of the mind. Behaviour theorists define learning as nothing more than the acquisition of new behaviour based on environmental conditions. Behaviorists such as Watson and Skinner construe knowledge as a repertoire of behaviours. Skinner (1976) argues that it is not the case that we use knowledge to guide our action; rather, knowledge is action, or at least rules for action. It is a set of passive, largely mechanical responses to environmental stimuli. Knowledge that is not actively expressed in behaviour can be explained as behavioral capacities. If knowledge is construed as a repertoire of behaviours, someone can be said to understand something if they possess the appropriate repertoire.

2.6.2.1 Behaviorist View of Learning

From a Behaviorist perspective, the transmission of information from teacher to learner is essentially the transmission of the response appropriate to a certain stimulus. Thus, the implication in educational perspective is to present the student with the appropriate repertoire of behavioral responses to specific stimuli and to reinforce those responses through an effective reinforcement schedule (Skinner, 1976). An effective reinforcement schedule requires consistent repetition of the material; small, progressive sequences of tasks; and continuous positive reinforcement. Without positive reinforcement, learned responses will quickly become extinct. This is because learners will continue to modify their behaviour until they receive some positive reinforcement. In view of this it is imperative that in the teaching of textile fibre identification lessons, students are constantly motivated to enhance learning. For example, a student who receives verbal praise and good grades for correct answers (positive reinforcement) is likely to learn those answers effectively; one who receives little or no positive feedback for the same answers (negative reinforcement) is less likely to learn them as effectively. Likewise, human learners tend to avoid responses that are associated with punishment or unpleasant consequences such as poor grades or adverse feedback.

Experiments by Behaviorists identify conditioning as a universal learning process. There are two different types of conditioning, each yielding a different behavioral pattern:

Classic conditioning occurs when a natural reflex responds to a stimulus. We are biologically "wired" so that a certain stimulus will produce a specific response. One of the more common examples of classical conditioning in the educational environment is in situations where students exhibit irrational fears and anxieties like fear of failure, fear of public speaking and general school phobia.

1. **Behavioral** or **operant conditioning** occurs when a response to a stimulus is reinforced. Basically, operant conditioning is a simple feedback system: If a reward or reinforcement follows the response to a stimulus, then the response becomes more probable in the future. For example, leading Behaviorist B.F. Skinner used reinforcement techniques to teach pigeons to dance and bowl a ball in a mini-alley.

2.6.2.2 How Behaviorism Impacts Learning

This theory relies only on observable behaviour and describes several universal laws of behaviour. Its positive and negative reinforcement techniques can be very effective– such as repeatedly doing an activity and antisocial behaviour. Behaviorism is often disorders including autism, anxiety disorders and antisocial behaviour. Behaviorism is often used by teachers who reward or punish student behaviours.

Behaviorist teaching methods tend to rely on skill and drill exercises to provide the consistent repetition necessary for effective reinforcement of response patterns. Other methods include question (stimulus) and answer (response) frameworks in which questions are of gradually increasing difficulty; guided practice; and regular reviews of material. Behaviorist methods also typically rely heavily on the use of positive reinforcements such as verbal praise, good grades, and prizes. Behaviorists assess the degree of learning using methods that measure observable behaviour such as exam performance. Behaviorist teaching methods have proven most successful in areas where there is a “correct” response or easily memorized material. For example, while Behaviorist methods have proven to be successful in teaching structured material such as facts and formulae, scientific concepts, and foreign language vocabulary, their efficacy in teaching comprehension, composition, and analytical abilities is questionable.

CHAPTER THREE

METHODOLOGY

3.0 Overview

This chapter delves into the research approach and design adopted, study area description, study population, sample and sampling techniques, research instrument, validity and reliability, data collection and analysis. The chapter also discusses ethical issues considered during data collection.

3.1 Research Design

This research was quantitative adopting the survey approach in collecting data. According to (Creswell, 2007), quantitative research explains phenomenon by using measurement and statistical analysis of numerical data. It is a blueprint for conducting the study that maximizes control over factors that could interfere with the validity of the findings. The research design was a descriptive survey. Essentially, it aims at establishing the status of the subject or phenomena under examination. According to Creswell (2007), a descriptive survey organizes studies that allow data to be analyzed and interpreted, to allow for a present report on the status of an organization, institution, community or school. The method describes and interprets what is happening in its present form or condition; practice and process, trend and effect and attitude or belief. The aim of survey is to obtain information that can be analyzed and patterns extracted and comparisons made.

Descriptive survey was chosen because it helps identify the current state of affairs which could inform Government and other stakeholders of education about current happenings within the particular sector so as to support and provide the necessary logistics to curb the situation.

3.2 Area of Study

The area for the study was Ho Municipality with a land area of 2361km^2. The municipality shares boundaries with Adaklu Agortime Municipality to the south, Ho west Municipality to the north and east. It is situated in Volta Region of Ghana with the coordinates 6° 36' 43"N 0° 28' 13"E. (GhanaMunicipalitys.com). The Municipality has eleven Senior High Schools and all of them run Clothing and Textiles programmme.

3.3 Study Population

The target population for this study was Clothing and Textiles Teachers in the Ho Municipality. This included teachers from the various Senior High Schools (SHS) in the Municipality *viz*: Dzolo, Kpedze, Ola, Mawuko Girls, Awudome, Taviefe, Tanyigbe and Mawuli, Senior High and Vane, Tsito, Akome and Sokode Secondary Technical Schools. In all a total of 31 Clothing and Textile teachers were identified in the study location.

3.4 Sample and Sampling Technique

The researcher adopted purposive sampling to select Clothing and Textiles Teachers from the selected schools because they were the only people who could provide meaningful data for this study. The census method was then used to select all the 31 Clothing and Textiles Teachers within` the municipality.

3.5 Instrumentation

The instrument used for data collection was the questionnaire. The questionnaire was developed by setting criterion questions from the research questions. Quantitative data for the study were obtained using closed-ended questions. There were two sections of the questionnaire, the first section is made up of respondents' demographic data and the second section arranged in three thematic areas in line with the objectives of the study.

These are the teaching methods employed for fibre identification and testing lessons, physical resources available for teaching textile fibre identification and testing lessons in Clothing and Textiles and strategies to be used to mitigate challenges in textile fibre identification and testing lessons.

3.6 Validity and Reliability

Validity is the degree to which an instrument measures what it purport to measure. Invalid instruments can lead to erroneous research conclusions, which in turn can influence educational decisions. Validity explains the accuracy of measurements (Ngansathil, 2001). The drafted questionnaire was given to other postgraduate students for peer review and they made suggestions that were incorporated to ensure validity.

Reliability analysis involves finding out the extent to which measurements of a particular test are repeatable. Reliability is the internal consistency or stability of the measuring device over time (Gay, 1996). It refers to the ability of an instrument to produce similar results at different times with the same group of respondents. The questionnaire was therefore administered to ten Clothing and Textiles Teachers who were on a postgraduate sandwich programme on campus at the University of Education, Winneba. Copies of the questionnaire were filled without any problems by the respondents, the data provided answered the research questions posed for the study and yielded consistent responses. Thus, the instrument proved to be valid and reliable. Finally, it was scrutinized by the supervisor to validate to ensure the data collected answered the research questions. The researcher ensured that the results from respondents are credible and dependable by using different questions which serve the same objective.

3.7 Data Collection

A letter of introduction was given to the head of the school to ask permission to use the school for the study. The researcher was introduced to the head of department for Home Economics who later introduced the researcher to members of the department. The intent and purpose of the study was personally explained to the staffs concerned before respondents were selected purposively on an agreed time.

To ensure maximum response rate, the researcher administered the questionnaire to respondents personally in order to provide explanations to areas that needed clarification. Respondents were asked to read through the questions to ask any doubtful questions for clarification. After the explanations, the questionnaires were left with the respondents to answer them at their own pace, to be collected later as agreed on by the researcher and the respondents.

3.8 Data Analysis

The responses to items in the questionnaire were coded and used to develop database using the Statistical Package for Social Science (SPSS) 21.0 version. The data were quantified and transformed into simple frequencies and percentages, the results were presented in tables and given quantitative interpretation and discussed with the relevant literature.

3.9 Ethical Consideration

High standards of ethics are required in an academic writing to forestall any likelihood of subjecting respondents of questionnaire to victimization or harassment. In this regard, the researcher sought permission from the Heads of the various SHS's before the questionnaire was administered to the respondents. The researcher was introduced to the teaching staff concerned. The intent and purpose of the study were personally explained to respondents, although the questionnaire itself contained an opening introductory letter requesting the respondents' cooperation in providing the required information for the study.

Since participation in the study was voluntary it avoided any attempt to insist on the inclusion of some particular persons. Respondents were advised not to include personal particulars such as name, contact numbers or anything that associate a respondent to any particular kind of information. Respondents were finally made to understand that the study was purely for academic purposes and were assured of anonymity.

CHAPTER FOUR

RESULTS AND DISCUSSION

4.1 Overview

This chapter presents the empirical findings of the study. It elaborates and interprets the findings in the data collection process using the research methods outlined in the methodology in the study to examine the methods used by the teachers to teach textiles fibre identification and testing lessons. The findings were set out to answer the research objectives stated at the beginning of the study. The objectives were;

1. Explore methods used by the teachers to teach textiles fibre identification and testing lessons.
2. Identify the challenges of teachers during the textile's fibre identification and testing lessons.
3. Identify strategies that can be used to mitigate challenges in textiles fibre identification and testing lessons.

4.2 Demographic Characteristics of the Respondents

The demographic data is based on the characteristics of the respondents in the Ho Municipality. In this study, a total of 31 structured questionnaires were administered to the respondents.

Table 4. 1 Demographic Characteristics of Study Respondents

Characteristics		Frequency (N=31)	Percentage
Sex	Female	23	74.19
	Male	8	25.81
Age			
	30-35	14	45.16
	36-39	10	41.94
	40-45	5	16.13
	46-50	2	6.45
Education			
	HND	1	3.2
	Diploma	3	9.68
	First Degree	20	64.52
	Masters	7	22.58
Experience in Teaching Clothing and Textiles (Years)			
	1-5	6	19.35
	6-10	15	48.39
	Above 10	10	32.26

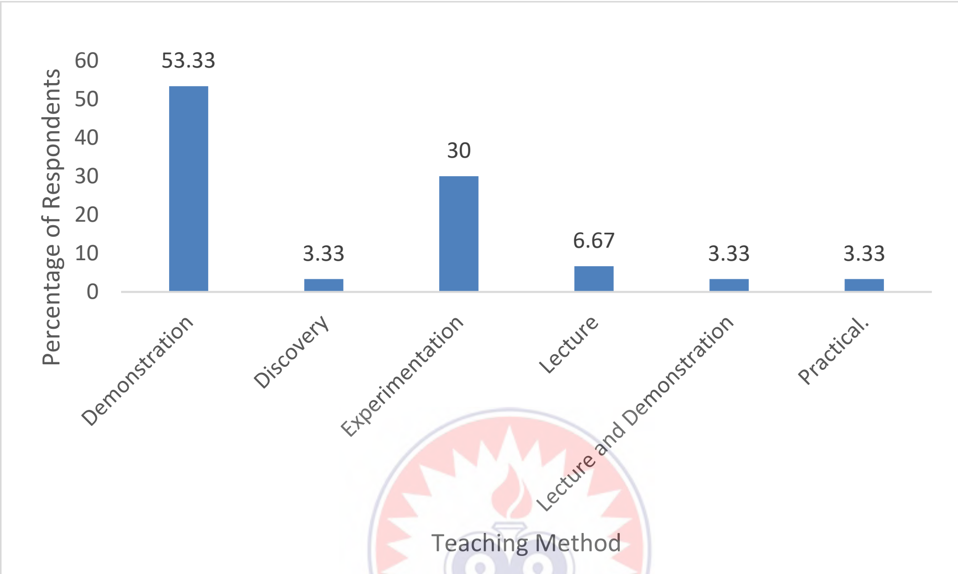
Source: Field Data (2020)

Table 4.1 shows the personal characteristics of study respondents. Out of the 31 respondents, 74.19% were females and 25.81% were males. The background information about sex indicates that, more females were engaged in teaching Clothing and Textile in the Ho municipality compared to males. Less than half of the respondents (45.16%) were between the ages of 30-35 and the minority age group of 6.45% were between the ages of 46 -50.

The level of education one attains tells the capabilities of the person in terms of thinking and adapting best teaching practices for textiles fibre identification. In view of this, the study sought to find out the educational levels of the respondents. It became clear that majority (64.52%) of the respondents had first degree education. Furthermore, 22.58% had a master’s education, whereas 3.23% had Higher National Diploma (HND) and 9.68% had diploma education.

In all, 48.39% of the respondents had 6-10 years of experience in teaching Clothing and Textiles, 32.26%% had experience of 10 years and above and minority (19.35%) had between 1-5 years of experience.

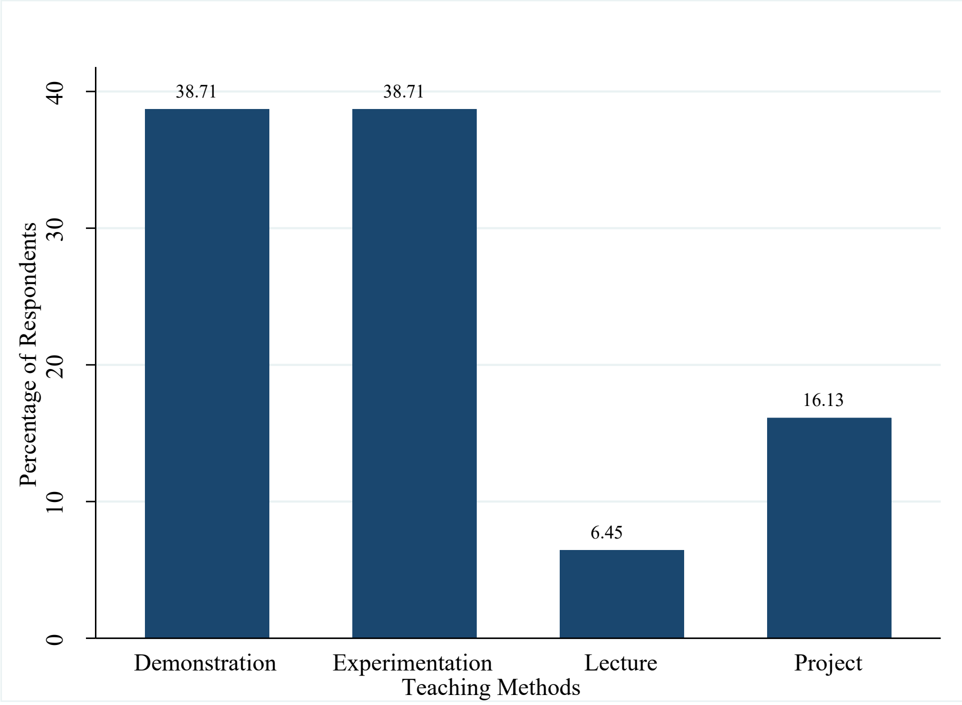
4.3 Methods Used by the Teachers to Teach Textiles Fibre Identification and Testing Lessons



Source: Field Data (2020)

Figure 4. 1 Teaching Methods used by teachers in teaching lesson

In order to explore the methods used by teachers to teach textiles fibre identification and testing lessons, teachers were asked to indicate which teaching method (s) they used in textile fibre identification lessons. The results indicate that 53.33 % used demonstration, 30% used experimentation, 6.67% used lecture, whereas 3.33% each used discovery, practical and lecture and demonstration combined.



Source: Field Data (2020)

Figure 4. 2 Teaching Methods that Students Mostly Partake in

Again, in exploring which methods students partook in, the results indicate that, 38.71% participated in class where teachers used either demonstration or experimentation. This gives a clear indication, the best method that works for students and the need for teachers to adopt such methods to ensure full class participation and involvement. This supports the assertion made by Susan (2019) that using demonstration method in teaching bridges the gap between theory and practice, enables learners to become good observers and generate their interest. The results are evident in figure 4.2.

Table 4 2 Opinions of Teachers on the most appropriate methods for the teaching of textile fibre identification and testing lessons

Teaching Methods	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
Lecture	18(58.06%)	2 (6.45%)	3(9.68%)	6 (19.35%)	2 (6.45%)
Demonstration	0 (0.00%)	3 (10.0%)	5 (16.67%)	9 (30.0%)	13 (43.33%)
Project	2 (6.45%)	2 (6.45%)	13(41.94%)	9 (29.03%)	5 (16.13%)
Experimentation	0 (0.00%)	3 (9.68%)	4 (12.90%)	6 (19.35%)	18 (58.06%)
Discovery	3 (9.68%)	3 (9.68%)	17(54.84%)	5 (16.13%)	3 (9.68%)

Table 4.2 shows results for the opinions of teachers on the most appropriate methods for the teaching of textile fibre identification and testing lessons. According to teacher's opinion, demonstration and experimentation (70.33% and 77.41% respectively) are the most appropriate methods for the teaching of textile fibre identification and testing lessons. This justifies why it was the widely used method by teachers in delivering their lessons. The findings also corroborate with results by Bernard (2016) that, instructional techniques which involve demonstration such as are role play, contract plan and team teaching are found to be very effective in teaching textiles.

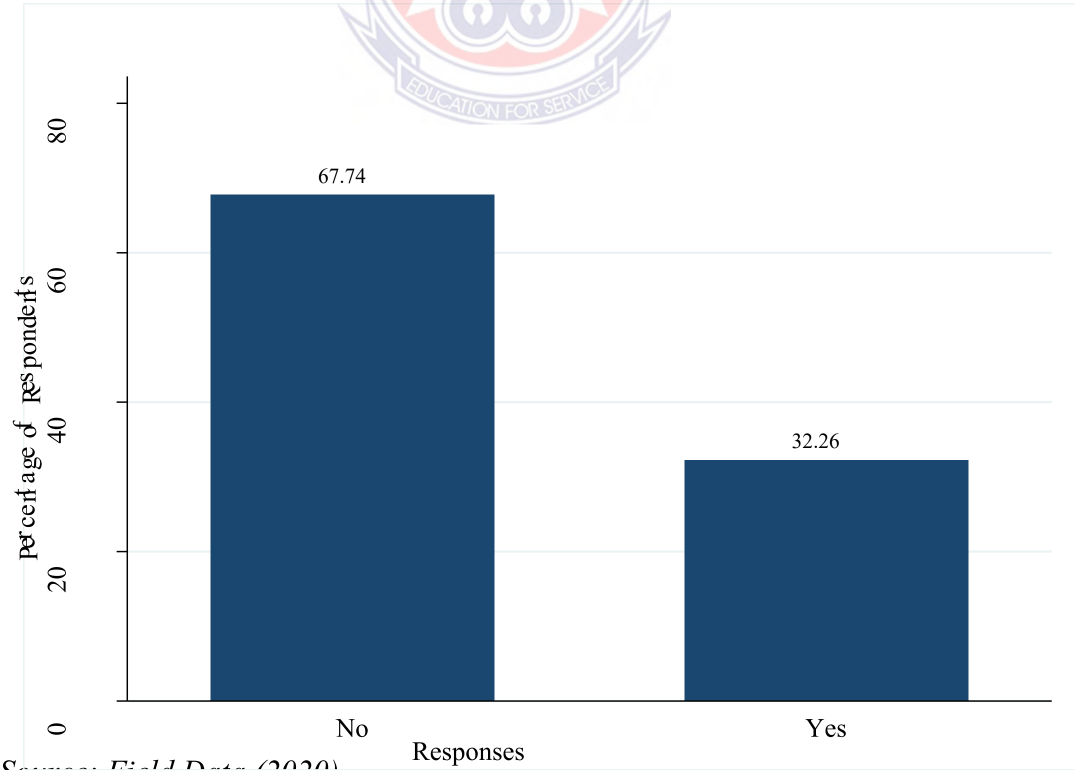
The use of methods like demonstration and experimentation which have been overwhelmingly endorsed by teachers -from the field survey findings- has been endorsed by educational theorist like Skinner who wrote:

> "From a Behaviorist perspective, the transmission of information from teacher to learner is essentially the transmission of the response appropriate to a certain stimulus. Thus, the implication in educational perspective is to present the students with the appropriate repertoire of behavioral responses to specific stimuli and to reinforce those responses through an effective reinforcement schedule (Skinner, 1976)", p 44.

With regards to the time duration allocated for textile fibre identification and testing lessons per week, majority (63%) used less than 3 hours as compared to the minority (37%) who used 3 hours and more. Again, 67.74% indicated that they were unable to complete the lessons within the given time period. These suggest that more time needs to be allocated in order to allow room for more practical session.

Finally, it was identified that 40.0% of student's carried out textile fibre identification lessons in the Home Economics Department, 33.33% in the classroom and 16.67% in the science laboratory. This means, most textile fibre identification and testing lessons are not carried out in the required environment (science laboratory), buttressing infrastructure and equipment challenges which hamper the effective delivery of the lesson.

4.4 Challenges Faced by Teachers during the Textiles Fibre Identification and Testing Lessons

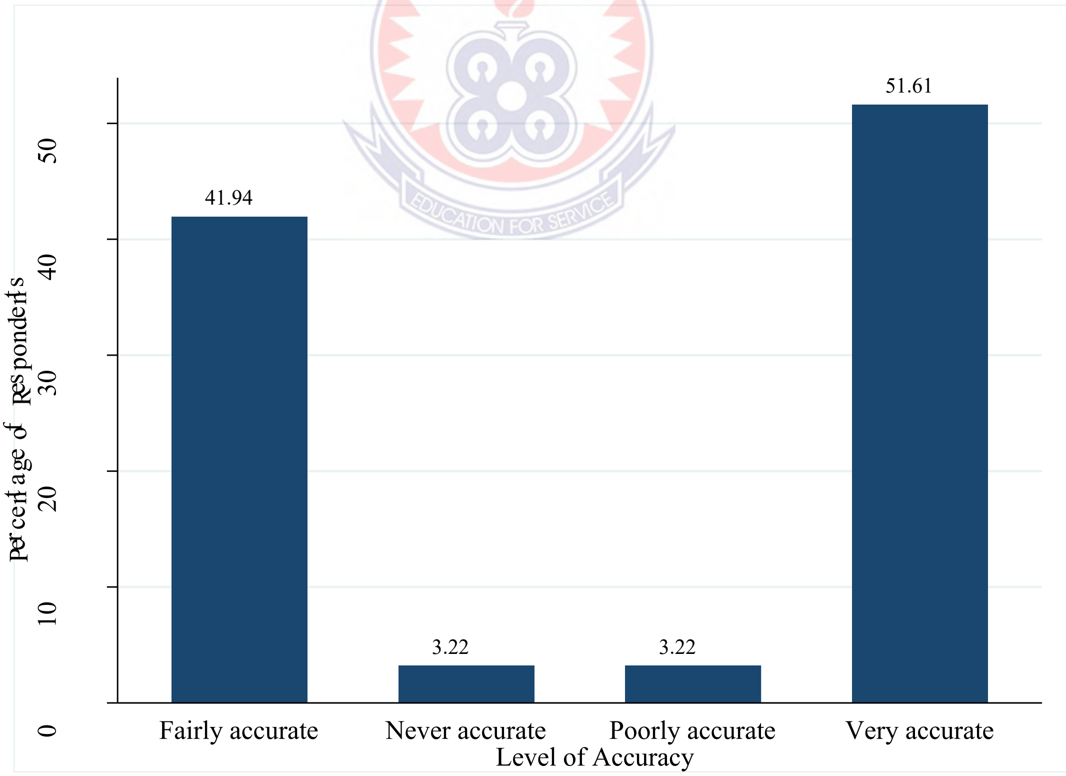


Source: Field Data (2020)

Figure 4. 3 Availability of Well-Equipped Science Laboratory

In identifying the challenges faced by teachers during textiles fibre identification and testing lessons, the results show that 67.74% did not have well equipped science laboratories (Figure 4.3). Consequently, teachers are unable to carry out microscopic fibre identification tests. This affects the quality of teaching and learning. Again, it was identified that, the specific challenges teachers faced with science laboratories included; inadequate teaching materials or equipment to perform specific tests, laboratories always in use by science students due to improper scheduling of classes and difficulties in accessing microscopes.

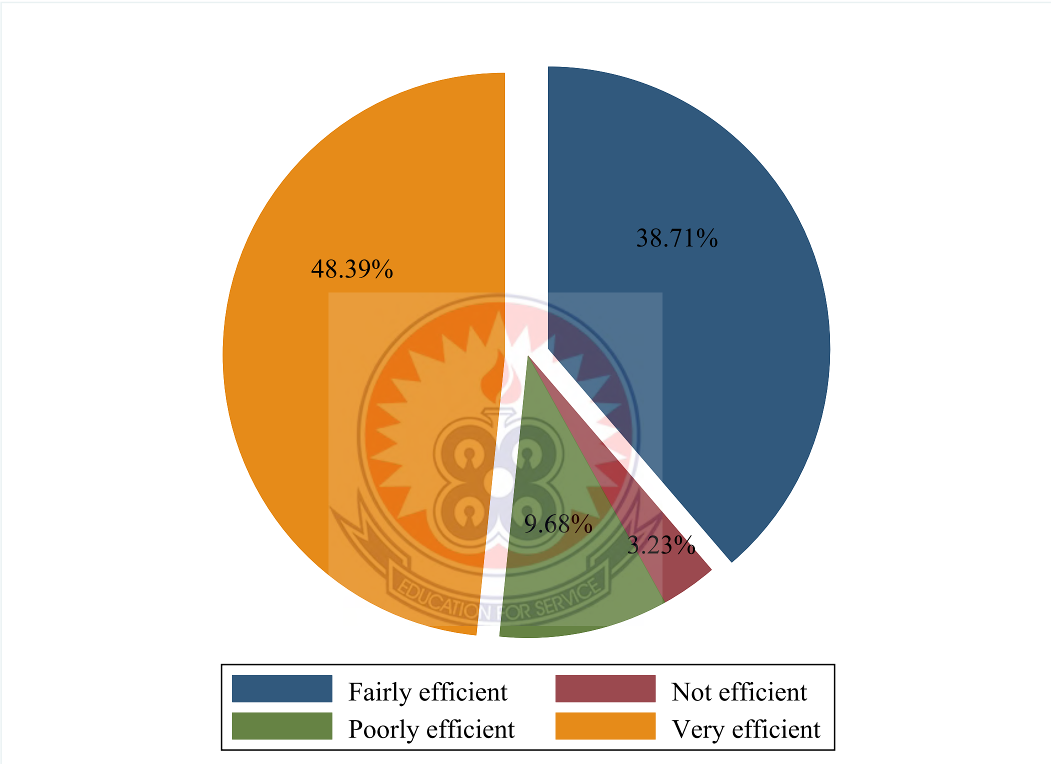
Further interrogation also revealed that 54.84% were unable to carry out solubility fibre identification tests due to non-availability of chemicals (43.33%), insufficient time allocation (20.00%) and non-availability of equipment (26.67%).



Source: Field Data, 2020

Figure 4. 4 Accuracy of Burning Test Results

With regards to the accuracy of the burning test in textile fibre identification lessons, 51.61% indicated that results obtained were very accurate as compared to 3.23% who indicated that results were never accurate (see Figure 4.4). This result is quite positive as compared to the performance of other test. However, challenges such as insufficient time allocation, inability of students to identify some of the end result of tests, injuries such as burns still persisted.



Source: Field Data (2020)

Figure 4. 5 Accuracy of Textile Fibre Absorbency Test

Finally, with regards to textile fibre absorbency test in textiles fibre identification and testing lessons, the results show that 48.39% indicated it was very efficient (See Figure 4.5).

4.5 The Teachers' suggestions for Strategies to Mitigate Challenges in Textiles Fibre Identification and Testing Lessons

Based on the challenges identified, some suggestions have been proposed by the teachers to help mitigate the negative effects on teaching and learning.

a) **Provision of Well-Equipped Science Laboratories**: To the teachers, there was the need to look beyond books and traditional teaching in the classroom in order to grasp the concepts. Effective teaching and learning of textile fibre identification and testing lessons involves seeing, handling, and manipulating real objects and materials. Also, unless students actually observe the process and understand the relationship between actions and reactions, the understanding that they attain in classrooms would be ineffective. Although it is the responsibility of government to provide such facilities, they indicated the burden should not be left only on their shoulders. School authorities can adopt innovative means such as engaging Parent Teacher Associations (PTAs), Old Students among others, in providing these facilities.

b) **Increase Time Allocation for Practical Lessons**: The provision of well-equipped science laboratories without getting students to actually use them effectively is pointless: in this regard the study participants (the teachers), suggested authorities in schools responsible for drafting school timetables to take into consideration the practical nature of the subject and make adequate provision in terms of adequate time provision. Where enough time allocation seems difficult due to other activities and subjects, they recommend extra time outside normal school hours or weekends to be included. This will enable student get a first-hand learning experience by performing various experiments on their own rather than rushing them through the practical lesson within the inadequate allotted time period.

c) **Clothing and textiles students should be encouraged to take elective chemistry as one of their elective subjects:** the teachers noted that there is a close relationship between the study of textiles and chemistry. In textiles and clothes, one can find a great range of chemicals. Some are used to give a certain effect to the product, such as biocides to prevent mould from growing on them, dyes to give particular colours to clothing and water repellents to make outdoor wears. Special chemicals are sometimes added to ensure that during long transport periods, the clothes does not become creased or mildewed. To remove bad odour, some clothes contain bacteria-killing agents. Oils and greases, starch, sulfonated oils, waxes and certain surfactants are also be found in textiles. Based on these inter-linkages, combining the study of textiles and chemistry helps in understating and relating concepts well. Additionally knowledge in chemistry brings about better understanding of tests and their anticipated results when students are carrying them out (absorbency and solubility tests for example). This they say can help prevent certain challenges faced by students such as inability of students to identify some of the end result of the tests, difficulty in identifying fabric blends, burn-related injuries and so on.

CHAPTER FIVE

SUMMARY OF FINDINGS, CONCLUSION, AND RECOMMENDATION

5.1 Overview

The chapter is divided into three main parts. The first section presents a summary of findings from the study. The second part covers the conclusion drawn from the findings, while the last part offers recommendations to stakeholders responsible for the Home Economics Education.

The topic under investigation was Challenges of Clothing and Textile teachers in textiles fibre identification and testing lessons at the Senior High School. The study had the following objectives;

1. To explore methods used by teachers to teach textiles fibre identification and testing lessons.
2. Identify the physical resources available for teaching textile fibre identification and testing lessons.
3. Identify strategies that can be used to mitigate challenges in textiles fibre identification and testing lessons.

To find out the nature of the challenges and ways to address the issue, the study focused on challenges of Clothing and Textiles teachers in textile fibre identification and testing lessons and adopted a descriptive survey design; sampling was purposive and involved all 31 Clothing and Textiles teachers in 13 Senior High and Technical Schools within the Ho Municipality that participated in the study.

5.2 Summary of Findings

5.2.1 Methods used by the teachers to teach textiles fibre identification and testing lessons

The study found out that 53.33% of the teachers used demonstration, 30% used experimentation, 6.67% used lecture, whereas 3.33% each used discovery, practical and lecture and demonstration combined.

5.2.2 Challenges of teachers during the textiles fibre identification and testing lessons

The results show that 67.74% of teachers indicated non- availability of well-equipped science laboratories and where they are available, the laboratories are in use by science students because of the notion that the laboratories are purposely for science students. As a result scheduling of classes in the laboratories does not factor the usage by clothing and textiles students to have access. Further interrogation also revealed that 54.84% of teachers were unable to carry out solubility fibre identification tests due to non-availability of chemicals. 43.33% due to insufficient time allocation, 20.00% due to non-availability of equipment.

5.2.3 Teachers suggestions for improvement in textiles fibre identification and testing lessons

The study found out that in order to do effective teaching and learning of textile fibre identification and testing lessons which involves seeing, handling, and manipulating real objects and materials, there should be provision of well-equipped science laboratories, increased time allocation for practical session and encouraging clothing and textiles students to take elective chemistry as a compulsory subject as this helps in understating and relating concepts in clothing and textiles better.

5.3 Conclusions

The following conclusions are made in line with each objective respectively:

1. The main methods used in teaching fibre identification and testing lesson are demonstration and experimentation.
2. The findings revealed that the main challenges teachers faced during the teaching of fibre identification and testing lesson are non-availability of well-equipped laboratories; and inadequate time allocation on timetable
3. Some of the strategies identified to mitigate the challenges include: provision of well-equipped science laboratories, increase time allocation for practical lessons and clothing and textiles students should be encouraged to take elective chemistry as one of their elective subjects.

Finally addressing the challenges in textile fibre identification and testing lessons might just be one of the many challenges that might exist in the teaching of clothing and textiles as a subject and immediate steps must be taken to identify and address these challenges to arouse interest in the subject and also promote national development in the area of clothing and textiles.

5.4 Recommendations

Based on the findings of the study, the following recommendations have been made:

1. Based on the finding that education at the Senior High School level should be stepped up in textiles fibre identification and testing lessons; policy makers in the Ghana Education Service and Curriculum Planning Division on various subjects should enrich the Senior High School syllabus with more current and detail methods of fibre identification and testing lessons.

2. Following the teachers complains that laboratories are either not available or where there are, they are ill equipped, the government should make available enough and accurate tools and equipment for the teaching of textiles fibre identification and testing lessons in the Senior High Schools.

3. Though this study did not focus on teacher competency in handling the lesson it would also be in the right direction if the Ghana Education Service organise frequent in-service training and refresher courses for Clothing and Textiles teachers to make them current in the delivery of textiles fibre identification and testing lessons.

5.4.1 Suggestion for Further Studies

This study should be replicated in other Senior High Schools in various districts and municipalities in the country to determine the widespread or otherwise nature of the challenges identified in this study. Additionally the study focussed on challenges involved in fibre identification and testing lessons but teacher competency could also be a reason for the poor manner in which the subject is handled and this could be an area for further investigations.

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APPENDICES

APPENDIX A

QUESTIONNAIRE

UNIVERSITY OF EDUCATION WINNEBA

DEPARTMENT OF HOME ECONOMICS EDUCATION

Introduction

This study is being conducted in partial fulfillment of the award of a *Master of Education degree in Home Economics* with the dissertation topic *"***CHALLENGES OF CLOTHING AND TEXTILES TEACHERS IN TEXTILES FIBRE IDENTIFICATION AND TESTING LESSONS IN HO MUNICIPALITY***"*. Information will be aggregated with those from similar interviews with other people and will be used for academic purposes in **Miss. Sahadatu Hamza** master's dissertation at the University of Education Winneba.
All information collected during this interview is confidential and no direct references will be made to individual respondents. Your support and contribution would be very much appreciated.

QUESTIONNAIRE FOR TEACHERS IN HO MUNICIPALITY

Section A: Demographic Characteristics of Respondents

Sex: Male [ ] Female [ ]

Age: ……………………………………………….

Highest Educational Qualification
Diploma [ ] 1st Degree [ ] 2nd Degree [ ] Other (please specify)

…………………………

Number of Years of Teaching Clothing and Textiles (Experience)……………………

B: Methods used teaching textiles fibre identification and testing lessons.

1. Which teaching method (s) do you use in textile fibre identification lessons?

   Lecture [ ] Demonstration [ ] Project [ ] Experimentation [ ]

   Discovery [ ] Others [ ] please specify……………………………

2. Which of these methods do students mostly partake in?

   Lecture [ ] Demonstration [ ] Project [ ] Experimentation [ ]

   Discovery [ ]

3. Others (please specify) ……………………………………………………………

4. In your opinion which of the listed methods below would be most appropriate for the teaching of textile fibre identification and testing lessons

1- **Strongly Disagree** 2- **Disagree** 3- **Neutral** 4- **Agree** 5- **Strongly Agree**

Please indicate your degree of agreement to each of the following, by circling the appropriate number under the "scale" section:	**SCALE**				
i. Lecture	1	2	3	4	5
ii. Demonstration	1	2	3	4	5
iii. Project	1	2	3	4	5
iv. Experimentation	1	2	3	4	5
v. Discovery	1	2	3	4	5

5. Any other Method……………………………………………………………………

6. What is the time duration allocated for textile fibre identification and testing lessons per week? ....

7. Are you able to complete the lessons within the given time period?

Yes [ ] No [ ]

8. Where do students carryout textile fibre identification lessons?

Classroom [ ] Home Economics Department [ ] Science lab [ ] Other (please specify)…………

9. How often are you able to carry out textile fibre identification tests?

Often [ ] Fairly often [ ] Not often [ ] Never [ ]

C: Challenges during the textiles fibre identification and testing lessons.

10. Does the school has a well-equipped Science Laboratory?
    Yes [ ] No [ ]

11. Are you able to carry out microscopic fibre identification tests?
    Yes [ ] No [ ]

12. How often?

    Often [ ] Fairly often [ ] Not often [ ] Never [ ]

13. What are the challenges faced?

    ....

    ……………………………………………………………………………………

    ………………………………………………………..……………………..

14. Are you able to carry out solubility fibre identification tests?

    Yes [ ] No [ ]

15. How often?

    Often [ ] Fairly often [ ] Not often [ ] Never [ ]

16. What are the challenges faced?

    Non- availability of equipment [ ] Non- availability of chemicals [ ]

    Insufficient time allocation [ ] Others (please specify) …………..

17. How accurate is the burning test in textile fibre identification lessons?

    Very accurate [ ] Fairly accurate [ ] Poorly accurate [ ] Not accurate [ ]

18. What are the challenges faced during burning tests?

    …………………….………………………………………………………

    ……………………………………………………………………………………

    ……………………………………………………………………………………

    ……………………………………………………………………………………

19. How efficient is textile fibre absorbency test in textiles fibre identification and testing lessons

    Very efficient [ ]   Fairly efficient [ ]   Poorly efficient [ ]

    Not efficient [ ]

20. In your opinion what should be done to promote textiles fibre identification and testing lessons ………………………………………………………...

    ………………………………………………………………………………

    …………………………...

    ………………………………………………………………………………

    ………………………………………………………………………………

    ………………………………………………………………………………

    …………………………..

    ....

THANK YOU FOR YOUR TIME