

WASTE FABRICS THAT CAN BE USED TO PRODUCE HANDMADE PAPERS WHEN COMBINED WITH THE PAPER MULBERRY BARK

By

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DECLARATION

I hereby declare that this submission is my own work towards the M.A. degree and that to the best of my knowledge, it contains no material previously published by another person nor material which has been accepted for the award of any other degree of the university, except where due acknowledgment has been made in the text.

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ABSTRACT

The problem studied focuses on how some of the things society perceives as waste can be best managed to prevent the problems that waste causes to the environment. The study focused mainly on identifying waste fabrics that could produce useful sheets of papers when combined with paper mulberry. In this context, waste fabrics included pieces of linen, cotton, wool, nylon, polyester and acetate fabrics from cutting floors of garment makers and old cloths that are no more of use to their owners. Paper mulberry is a plant grown purposely for papermaking because of the cellulose content in its inner bark which makes it suitable for making paper. The waste fabrics were combined with paper mulberry inner bark in the ratio of 30% paper mulberry and 70% waste fabrics to produce handmade papers. Colour pencils, watercolour, pastel, poster colour, oil and acrylic paints were tested on the papers produced from the identified fabrics. In addition, miniature books were made from the sheets to ascertain their suitability for book making as well as their adaptability to usage as writing pads. The linen, cotton, nylon, polyester, wool and acetate waste fabrics. The study introduced the outcome of the experimental work to selected art teachers in the Kumasi metropolis so that they could also introduce this art to their students in school. Three research questions that guided the study were: How can experiments be carried out to identify waste fabrics that can produce useful papers when combined with the bark of the paper mulberry plant? How can the identified fabrics be used to produce sheets of paper to be used in making art? How can the workshop with the teachers be carried out? Findings from this qualitative research approaches used were experimental, descriptive and action research methods with participant observation and interviews. The population studied consisted of Primary, Junior and Senior High School art teachers in Kumasi. The convenience sampling

technique was used to select 20 schools and purposive sampling was used to select one art teacher each from the 20 schools.

From the experiments conducted, it was discovered that cotton waste plus paper mulberry, the combination of linen, cotton plus paper mulberry can produce useful sheets that can be used as writing pads. Nylon, polyester, wool, and acetate sheets could not be used as writing pads. Cotton waste plus paper mulberry, the combination of linen, cotton, plus paper mulberry sheets can be used for colour pencil and pastel works conveniently without problems. Sheets from nylon, polyester, wool and acetate waste fabrics cannot be used for colour pencil and pastel works. Cotton plus paper mulberry sheets can conveniently support watercolour works, but because of the fast absorption, drying and bleeding nature of the watercolour paint on the linen, nylon, polyester, wool, acetate and the combination of linen, cotton and paper mulberry sheets, working with the watercolour paint on the sheets is not very convenient. Linen, cotton, nylon, polyester, wool, acetate and the combination of linen, cotton and paper mulberry handmade sheets can all give a good support to oil and acrylic paints. Linen, cotton, nylon, polyester, wool, acetate, and the combination of linen, cotton and paper mulberry sheets can support poster painting excellently.

From the workshop organised for the selected teachers, it was deduced that for waste recycling to become part and parcel of individual Ghanaians, it will take education and this education can start from schools. From the study, it was proposed that the government should establish a paper and pulp mill in Kumasi for papermaking. Ghana Education Service (GES) should organise annual workshops for Creative Art teachers in Primary and Junior High schools to teach the teachers the hand papermaking processes. Schools in Ghana must set up practical recycling programmes and activities in their schools, to help instill the need and importance of recycling of

waste materials in students. To sustain recycling programmes and activities in schools, heads of schools must be willing to provide basic equipment and tools that students will need to work with. Further research must be carried out to identify recyclable waste materials that can be adopted for recycling.

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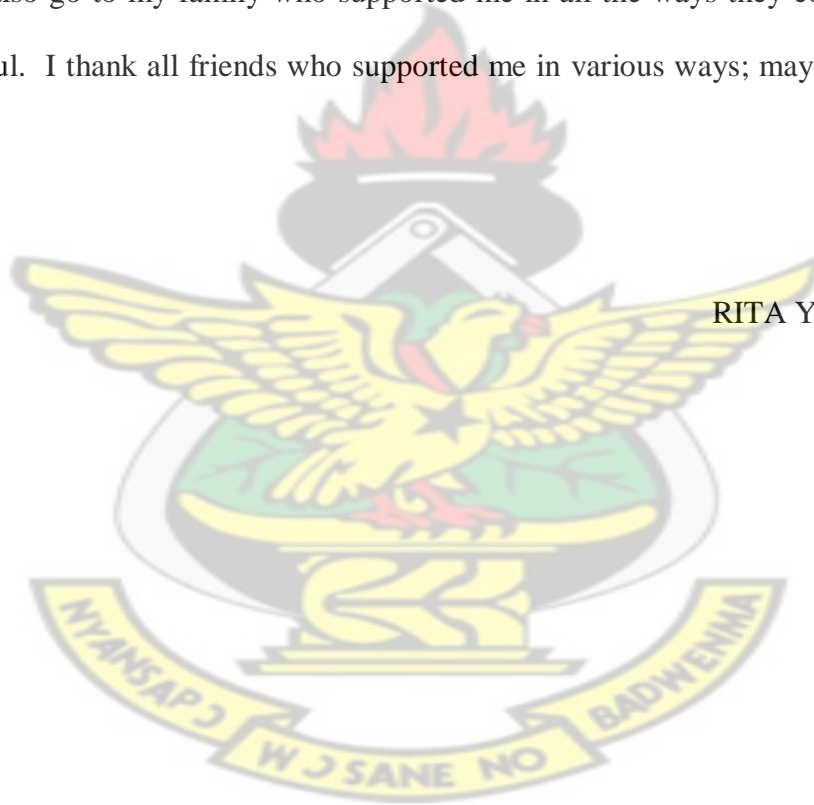


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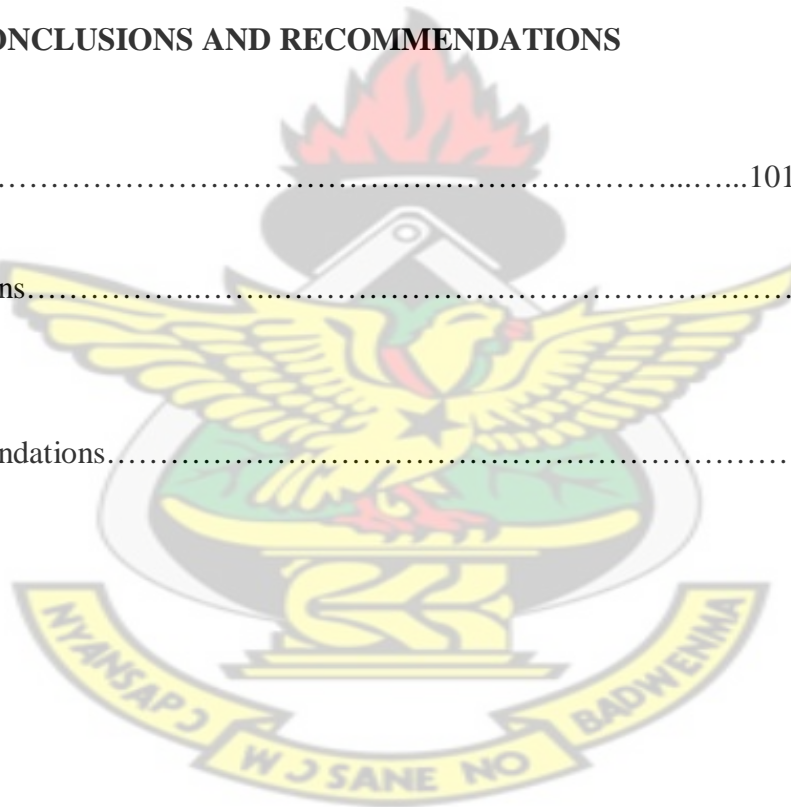
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ABBREVIATIONS

KNUST: Kwame Nkrumah University of Science and Technology

JHS: Junior High School

SHS: Senior High School



CHAPTER ONE

INTRODUCTION

1.1 Overview

The chapter introduces the study by outlining the background of the study, the problem studied and the objectives the study hoped to achieve. In addition, the geographic location and the importance of the study have all been discussed.

1.2 Background to the Study

In the days of old, the generation of waste was such that it got naturally recycled biodegradably. After the advent of the industrial revolution, different types of waste, each with its own environmental impacts, have come into existence. Waste has been defined as any product or substance that has no further use or value for the person or organisation that owns it, and which is, or will be, discarded. However, what may be discarded by one party may have value to another (Caulfield, 2009). The amount of waste generated, and its actual or potential negative effects on the environment, are matters of concern to governments and communities at large.

This project focused on identifying waste fabrics that could make useful sheets of handmade paper when combined with the inner bark of paper mulberry. The waste fabrics used were pieces collected from the floors of garment makers and clothes which were of no use to their owners. The idea was developed out of the quest to find a way to put back to use the many fabric wastes that always end up in landfills. Like all wastes, waste fabric originates from the community via a number of streams which includes the textile and clothes manufacturing industry and their consumers.

The paper mulberry plant, which is scientifically known as *Broussonetia papyrifera*, has played a significant role in the development of paper which is now indispensable to countless people all over the world (Barker, 2002). The paper mulberry plant though can be found in Ghana, is not used for the main purpose of its cultivation, which is paper production. Paper mulberry plant contains cellulose that gives good bonding qualities to paper pulp. This quality of the plant is the main reason behind the researcher combining paper mulberry with waste fabrics for useful hand papermaking. The concept of hand papermaking evolves essentially from the fact that the operations involved in making the sheets of papers are carried out manually, with raw materials to be pulped mechanically instead of using chemical pulping methods.

1.3 Statement of the Problem

Paper is a vital commodity that is used in communication, education, designing, packaging, and also for household use. In Ghana today, most of the papers used for these purposes are imported. In the past quarter of the century, Ghana has tried to look for avenues to set up its own pulp and paper mill, but to no avail (Darkwa, 1996). Paper mulberry, which is a plant used in producing paper, can be found in great quantities at *Abofoc* in the Ashanti Region but this material is not being put to any use. Bosu, Apetergor and Refera (2009) confirm this and

state that paper mulberry was cultivated in Ghana in 1969 for the purpose of starting a pulp and paper industry with the plants, but up till now that goal has not been achieved. Upon this realisation, the research focuses on a papermaking project where waste fabrics were combined with paper mulberry bark to produce useful papers that can be used in making miniature books and sheets that can support different drawing and painting mediums.

The decision to use waste fabrics was defined by the essential need to manage and dispose of fabric waste to solve some of Ghana's environmental problems. The culture of recycling and reusing waste material is not very common in Ghana. The problem of obtaining paper to support creative activities in schools is also another problem. The challenge therefore was to find a means to recycle fabric waste and introduce selected art teachers in Kumasi to the process and products as an opportunity for them to get into the habit of improvising teaching and learning materials as a creative process in art making.

1.3 Objectives

1. To identify waste fabrics that can be used to produce handmade papers when combined with the paper mulberry bark.
2. To produce paper from the identified waste fabrics and the paper mulberry bark.
3. To test different drawing and painting mediums on the produced papers and also create miniature books out of the produced papers.
4. To organize a workshop for twenty selected art teachers in Kumasi and introduce them to the process followed and the outcome of objectives one to three.
5. To follow up on the teachers who attended the workshop to find out what they did with the skills they acquired at the workshop.

1.5 Research Questions

1. How can tests be carried out to identify waste fabrics that can produce useful papers when combined with the bark of the paper mulberry plant?
2. How can the identified fabrics and paper mulberry be used to produce sheets of papers to be used in art?

3. How will the testing of the drawing and painting mediums on the papers and making of miniature books be done?
4. How can a workshop with teachers on hand papermaking be carried out effectively?
5. How will the follow up with the teachers be carried out?

1.6 Delimitation

The researcher worked with only waste fabrics because of their cellulose content and their availability all over Ghana in dressmaking and tailoring workshops. Waste fabrics that were accessible include linen, cotton, nylon, polyester, wool and acetate. Paper mulberry bark was used in this project. Drawing and painting mediums that were experimented on handmade sheets were limited to colour pencils, watercolour, pastel, poster colour, oil and acrylic paints. The study was conducted in Kumasi in the Ashanti Region.

1.7 Definition of Terms

Mould: wooden frame covered with a rubber mesh used for forming sheets of paper by hand.

Deckle: a wooden frame placed to the edges of a mould to define the edges of a sheet in hand papermaking.

Pulping: the process of blending raw materials like paper mulberry bark and fabric scraps in water.

Pulp: the end product of blended raw materials like paper mulberry and waste fabrics with water.

Couching: transferring a wet sheet from a mould onto a felt.

Felt: a material that has the ability to absorb water from a wet handmade sheet.

Paper mulberry: a plant grown for papermaking because of the high cellulose content in its inner bark.

Waste fabrics: pieces of unwanted fabrics on the floors of garment makers and unwanted clothes ready to be thrown away.

Moist semi-deciduous forest zone: an area that experiences a lot of rainfall.

Dry semi-deciduous forest zone: an area that experiences less rainfall.

Bleeding: a situation in which the pigment in a painting medium seeps through handmade sheets to the back.

Cellulose: the main substance in the cell walls of plants, which is used in making plastic products and paper.

Fibre: plant strands removed from the stems or leaves of plants.

1.8 Importance of the Study

The project brings to light the usefulness and reuse of waste items to ease pressure on landfills and other places like gutters and roadsides where waste materials collect and thereby

protecting the environment. This project has identified waste fabrics that can be combined with paper mulberry bark to produce useful sheets of papers which can be used for miniature books and can also support drawing and painting with pencil colours, watercolour, pastel, poster colour, oil and acrylic paints. The project has discovered an important use for fabric scrap or un-used textiles that are often thrown away or burnt.

The workshop has exposed the selected teacher participants to recycling of fabric waste. This helped to challenge four of the teacher participants to introduce the knowledge and skills they acquired at the workshop to their students through a practical recycling process. The rest of the teacher participants may also introduce what they learned at the workshop to their students to help educate them on waste reuse and recycling. This is also important because when students are introduced to practical recycling activities, it can encourage them to become responsible citizens who will help protect their environment. The report also serves as a reference material for interested individuals who would want to acquire knowledge in hand papermaking with fabric scraps.

CHAPTER TWO

REVIEW OF RELATED LITERATURE

2.1 Overview

The chapter provides a review of literature related to hand papermaking. The purpose is to know and get ideas from what is already known on the topic. The review deals with the following topics:

History of Hand Papermaking

The Nature of Paper Mulberry Plant in Handmade Papermaking

Textile Waste Recycling

Why Textile Waste Recycling?

Recycling Textile Waste: What Has Been Done Already

Obstacles in Textile Waste Recycling

Equipment and Materials That Teachers Can Use to Make Handmade Papers

Papermaking Organisations That Recycle

Organising and Teaching Hand Papermaking

The Need for Teachers to Inculcate the Recycling Attitude in Students

2.2 History of Hand Papermaking

According to Vickerman (1995), those who write about the history of papermaking agree that the craft was invented about 105 A.D in China. The early Chinese paper appeared to have been made from hemp waste through a process of washing, soaking and beating into pulp with a wooden mallet. A paper mould made of a sieve of coarsely woven silk stretched on a four-sided bamboo frame was used to dip up the fibre slurry from the vat and hold it for drying. The sheets were dried in an oven. Later a smooth material, often a fine woven silk was used to cover the mould which allowed the papermakers to free the newly formed sheet to dry on a flat surface, usually the walls of their houses. The Chinese brought the art of papermaking to a high degree of perfection but after the middle of the 8th century, the quality of their paper rapidly deteriorated.

Vickerman (1995) says that the oldest paper known dates to about 151 A.D. It was very thin, transparent, and of a very white colour. In the 5th century, the papers were all thick and of a dull buff colour while those of the latter half of the 6th and the 7th centuries were golden yellow and thin. By the beginning of the 8th century, Vickerman says the Chinese paper was thick, flabby and of a dull buff colour with an uneven texture that gave a poor resistance to ink. Although papermaking was a closely guarded secret in China for 500 years, the process migrated to Korea sometime around the 6th century A.D. In Korea, paper was prepared from fibres of hemp, rattan, mulberry, bamboo, rice straw and sea weed. Eventually it is believed a Buddhist monk from Korea introduced papermaking to the Japanese. As papermaking moved to Japan, three plants were discovered that produced thin translucent papers of exceptional quality. The most common paper was made from the inner bark of the mulberry tree.

Vickerman (1995) adds that in 751 A.D., the papermaking skill had spread via war to the Arabs. Hand papermaking in India is believed to have employed many thousands of people in mills located in various parts of that country. Most of the paper made in India was used for account books by merchants and money lenders. It took nearly 500 years after the invention of papermaking in China for papermaking to reach Europe because the early paper was disfavoured by the Christian world as a manifestation of Moslem culture. Spain was therefore the first European country to manufacture handmade paper during the middle of the 12th century. The migration of papermaking to America resulted from the immigration in 1690 of a Dutch papermaker, William Rittenhouse, to America. Rittenhouse established the first paper mill in Pennsylvania. Vickerman (1995) mentions that America and England chose cotton or linen rags to make their papers instead of plant fibres.

2.3 The Nature of Paper Mulberry Plant in Handmade Papermaking

Bosu, Apetergor and Refera (2009) describe the paper mulberry plant as being particularly native to Japan and Taiwan. It is a small, very fast-growing plant that is made up of both male and female species. The small leaves of the species are simple with serrated margins and the bigger leaves appear having between three and five lobes (see Plate 2.1). The fruit of both male and female species shows red and yellow colours; the plant flowers and fruits twice in

a year that is from January to March and June to September. The mulberry plant attains a height of 3-4 meters over a period of 12-18 months and can grow to a total height of 12metres.

According to Bosu et al (2009), in Ghana seedlings of both male and female species were first planted around the Afram head-waters and in the Pra-Anum forest reserves in the Ashanti Region in 1969. The reserves are located within the moist semi-deciduous and dry semi-deciduous forest zones, respectively. The officer in charge who planted the mulberry seedlings was called Yorke so the plant is locally called “Yorke” in the areas around the Afram head-waters and Pra-Anum forest reserves. The objective for planting the seedlings of the mulberry species in 1969 was to establish a supply base for a pulp and paper industry in Ghana. The high density of paper mulberry plant in the two forest reserves and nearby reserves was facilitated by a severe deforestation that the reserves experienced after their cultivation. This allowed the mulberry plant to spread uncontrollably in vast areas in the reserves, because the plant grows well and fast in non-dense canopy areas. The paper mulberry plant has the ability to replace itself very fast through its stumps after harvesting. The Forestry Research Institute of Ghana (FORIG) is reported to have been working to identify ways to control the invasiveness of the mulberry plant. Currently, Ghana and Uganda are the only two tropical African countries where the species have been reported to thrive. (Bosu et al, 2009).



Plate 2.1:

Different species of the paper mulberry plant in Ghana

McMinn (2004) discusses the invasiveness of the paper mulberry species by saying that “Plant a tree and you have a full forest in a decade” (p 1). Birds relish the fruit and disperse the seeds widely; the plant is also distributed by flood waters which wash away cuttings to establish new growths kilometres away. Once it becomes firmly established, it is extremely difficult to control and impossible to eliminate the paper mulberry plant. The tree is most obvious in early winter, as the leaves yellow and fall to the ground. During the growing season, the adult tree is

easily distinguished by its large, rounded leaves, which makes it stand out against the backdrop of other species. The leaves on young plants are also highly ornamental.

Morgan and Overholt (2004) add that paper mulberry is an exotic invasive plant which can quickly colonise vast areas. This important plant that played a very important part in shaping world history has unfortunately now become better known as an unwelcome weed of natural areas worldwide. The tremendous range of the plant shows its ability to thrive in various climates throughout the world. Paper mulberry spreads by means of its fruits which are spread to significant distances by local wildlife which enables it to enter and colonise gaps deep within an undisturbed area. Once established, paper mulberry spreads from its root system, forming dense thickness which is often thirty feet across. This plant which is native to Eastern Asia has become an invader on several continents and in many countries. According to Morgan and Overholt (2004), the World Conservation Union lists paper mulberry as one of the six worst plant invaders in Pakistan and recent studies have shown that it is also one of the top foreign invasive plants in Pampa grasslands in Argentina.

On how the Japanese prepare their paper mulberry for papermaking, Barrett (1983) indicates that before the inner bark which yields the fibre essential for papermaking is obtained, the stalks of the plant are harvested by cutting and packing the stalks in a steaming box built on a cast-iron cauldron filled with water to generate the steam. The bottom section of the steaming box (about 30cm² in its floor part) allows heat to enter freely from the cauldron below to the top section which is built with a solid cover to prevent any loss of heat. After packing the stalks in the steaming box, the box is covered and heat is applied under the cauldron and as the water boils the heat that comes out steams the stalks.

After two hours of steaming the stalks are removed and the Japanese strip the softened bark from the wood of the plant. The steaming ensures easy removal of both the inner and outer bark from the wood. After stripping, the outer bark is carefully removed from the inner bark which is the fibre suitable for papermaking. At this stage the inner bark is further cooked and cleaned. Cooking and cleaning the inner bark of the mulberry plant to a large extent determines what the finished paper's characteristics will be. Bark cooked with more chemicals for a longer period will produce softer papers and bark processed with minimum chemicals for a shorter period of time produces stronger papers.

According to Barrett (1983), the cooking process consists of boiling the inner fibre in an alkali solution such as soda ash or caustic soda to dissolve the lignin, wax and gums in the mulberry fibre. After cooking, the fibres are rinsed and cleaned with water to ensure that the fibre is free of the cooking solution. After a thorough cleaning and rinsing, the cooked fibre is beaten into pulp with a mallet on a hard surface for papermaking by the Japanese. Calligraphy papers, envelopes, decorative papers, business cards, notebooks, and papers for art work are some of the things the Japanese use the mulberry fibre for. While leaves of the mulberry plant are used in feeding livestock in Ghana, they are used in feeding silk worms in Japan (Barrett, 1983).

According to Farnsworth (1989), to create a whiter final paper, it may be desirable to lighten the fibre colour of the mulberry plant through bleaching. Three techniques for bleaching the fibre are:

1. Sunlight bleaching: the simplest and mildest method for whitening cooked mulberry bark is the use of the bleaching power of the sun. That is, after cooking and rinsing the fibres thoroughly, the fibres are spread out in direct sunlight in a tray of water. In using the sun light as a bleaching agent the fibres must not be allowed to dry, as re-cooking may become necessary if fibres are dried.
2. Hydrogen peroxide bleaching: in using this chemical, the cooked and carefully rinsed bark of the mulberry is placed in a bucket with enough hydrogen peroxide solution prepared and added to the mulberry bark in the bucket while ensuring that the solution covers the fibres. At this point the power of the hydrogen can be adjusted or increased by adding a pinch of soda ash to the solution in the bucket and stirring the solution with the fibres. After this process when the desired whiteness is obtained the fibres can be removed and rinsed thoroughly in water and the fibre can be reduced into pulp.
3. Chlorine bleaching: the cooked fibre is placed in a bucket filled with water which covers the fibre. When this is ready one cup of chlorine bleach is added to the water in the bucket and stirred. This mixture is then allowed to sit for a while to ensure that the desired whiteness is achieved. When the desired whiteness is achieved, the fibres can be removed and rinsed with water to get them ready for pulping.

The issue about the invasiveness of the mulberry plant in Ghana also gives a backbone to this project which would rather put the plant to its purposeful use in papermaking which is the aim for which paper mulberry was introduced into Ghana.

2.4 Textile Waste Recycling

Aggarwal (2010) explains that recycling means taking materials from products that one has finished using and trying to make new products out of them. It involves processing used materials into products to prevent waste of potentially useful materials. The two types of textile

waste are pre-consumer or post-consumer waste. Caulfield (2009) further explains that pre-consumer waste includes all the waste manufacturers generate during processing of fibres into fabrics and all floor cuttings that garment manufacturers generate. On the other hand, post-consumer textile waste consists of all types of garments or household textile that consumers no longer need or use and are disposed of. Barry explains that textile recycling is one of the oldest forms of recycling, having started in 1813 when Benjamin Law of West Riding area of Yorkshire pioneered the process of 'pulling', a process which involved breaking down woollen textiles into their constituent fibres so that they could be re-spun into fresh thread.

Barry (2000) explains that while the textile industry has a long history of being careful with its resources, a large proportion of unnecessary waste is still produced each year, much of which is either incinerated or disposed of in landfills. One reason for the increase in textile waste is consumer reaction to changes in fashion, both in clothing and household interior designs. Seasonal changes in fashion means that clothes become outdated quickly, encouraging replacement and disposal of clothes. This trend allows manufacturers to increasingly develop clothing in response to this 'throwaway society' one finds oneself in.

2.5 Why Textile Waste Recycling?

Caulfield (2009) reports that the three main reasons why it is necessary to recycle waste are: waste disposal in landfill can harm the environment and human health, the requirement of landfill space is reduced when waste is recycled, and the costs for landfill disposal which is continuously increasing is also reduced when waste is recycled. Textile waste in landfill contributes to the formation of leachate the liquid produced from the decomposition of waste within the landfill as it decomposes, which has the potential to contaminate ground water. Incinerating textile waste in large quantities also emits organic substances such as acidic gases and dust particles which are all harmful to humans and the environment.

El-Nouby, Azzam, Hohamed, and El-sheikl (2005) agree that it is appropriate and desirable to have a method and means for recycling textile waste back into useful products, because ecologically recycling conserves natural resources like water, trees and other minerals. Disposal of large volumes of textile waste is an increasing problem for the apparel industry. The rising costs, reduction of available space and concerns for the environment are making burying and land filling of textile waste declining options. Recycling of textile waste, if organised and done properly, can generate a livelihood for unskilled workers in developing countries; and when citizens begin to perceive waste materials as potential recycling materials, it can propagate the concept 'waste is money' in the country.

Furthermore, recycling may be considered economically beneficial in developing countries because it provides significant employment opportunities to a large informal sector. The labour intensity of certain recovery processes enables numerous people to amass some kind of income (Beukering and Duraiappah, 1996). Bullman (2007) stresses that reducing waste, reusing materials and products, and recycling are some of the most powerful ways individuals, households, institutions and businesses can protect their communities and the environment.

Using fabric waste for hand papermaking is therefore a good option for cleaning the environment and putting resources to good use.

2.6 Recycling Textile Waste: What Has Been Done Already

Barry (2000) estimates that up to 95% of the textile waste that are land- filled or incinerated every year could be recycled. Caulfield (2009) also acknowledges that today recovering textile waste or recycling is a multibillion dollar global industry that performs a vital social and environmental function and provides employment for millions of people all around the world. Barry explains that one of the major uses for recycled textile waste is in the making of cleaning and wiping rags. The cloths are usually stripped of all added materials such as buttons and zips before being cut into strips to make the wiping rags. The use of textile waste as a filling or flocking material in the United Kingdom has benefited greatly from its legislation prohibiting the use of foam in certain furnishings.

The process of producing filling or flocking is similar to that of wiping rags, with external attachments being removed before the material is shredded into pieces. As the shredded fabric will be hidden from sight when finally used, the individual fibres resulting from this process do not need to be separated by colour or quality. Textile waste has also been used by some innovative merchants for a wide range of other purposes such as for soundproof blocks, insulation, roofing felt, and as pollution control filters. By recycling textile waste, merchants are reducing the demand and use of virgin resources.

El-Nouby, Azzam, Hohamed, and El-sheikl (2005) say only a small portion of each waste type is being recycled or reused today. In an era of limited resources and increasing population, it is desirable to reclaim and reuse as many resources as possible but this is not the case, as much of the cotton waste that is generated goes directly to landfills. For many years wool clothing and other types of woollen products have been torn apart and the fibres reused in clothing and wool rugs by the textile industry. Caulfield (2009) shares the view that it is necessary to recover and reuse as many waste resources as are available because more often than not, all textile waste scraps are unrealised sources of valuable raw materials that can be repurposed or regenerated into saleable and usable products by intelligent collection, sorting, reengineering and reprocessing. When this is carried out properly, the liability of “waste” is turned into an asset. Caulfield mentions that one patent company trademarked “Flip™” utilizes textile waste collected from the cutting floor of garment manufacturing facilities to produce carrier bags and wrapping materials.

Purchasing recycled products completes the recycling process. By buying products with recycled contents, primary resources are conserved. Governments, as well as businesses and individual consumers, each play an important role in making the recycling process a success (Aggarwal, 2010).

2.7 Obstacles in Textile Waste Recycling

El-Nouby et al (2005) disclose that textile waste can be managed in different ways according to the raw material type and the society's awareness toward the relative environmental problem. But despite the known desirability of reusing waste resources and the known recycling of woollen products for many years, attempts to reclaim and reuse fibres from old garments, scraps, and rags have encountered large obstacles which have always prevented the development of a practical and commercial approach.

Some people in their attempt to reuse waste materials for useful products turn out making relatively low value goods which often have a very short useful life. This problem of making low value goods out of waste materials echoes Caulfield's (2009) view that turning 'waste' into an asset does not happen just like that but depends largely on specific training and development. Caulfield explains that the limited and inadequate data available regarding the amounts and types of textile waste in a country is an impediment to intelligent and effective recovery and regeneration of textile waste.

According to Caulfield, limited efforts to stimulate waste resource recovery through policy instruments that influence recycled demand, like the United Kingdom legislation on filling and flocking that Barry (2000) discloses, downplay waste recycling and creates a greater pull in the resource recovery system. There are also few targets and mandatory requirements in terms of recycled content being purchased for public sector agencies. The recycling industries' contribution to protecting the environment would not be possible without its significant expenditure on often highly sophisticated machinery and equipment. To that end, government policy is the instrument that will encourage investment in an industry that will regenerate textile waste. The recovery of post-consumer textile waste is dependent on consumers, so the use of recycled materials in products cannot be achieved with an uneducated public.

The management of waste is a difficult problem. However, the overall guiding principle, agreed upon by everyone in protecting the environment, is to reduce, re-use or recycle waste, and actual disposal of waste should be a last resort (Katkara and Bairgadar, 2010). This brings to bear the harm which textile waste can cause the environment, thereby justifying the need for it to be recycled instead of dumping it at landfill sites. The awareness is also created of the fact that space for landfill sites as well as money for constructing the sites is saved for use in other developmental areas. At the same time, employment opportunities are created through recycling. The challenges faced in textile waste recycling and products that some companies have made out of textile waste can however, not be overlooked.

2.8 Equipment and Materials That Teachers Can Use to Make Handmade Papers

According to Smith (1995), equipment and materials for making handmade papers range from equipment and materials that are very expensive to equipment and materials that can be scrounged free from the environment. Depending on how simple or elaborate a person wants the papermaking project to be, there are many quality grades and price ranges to choose from. Another thing instructors need to know is that most of the equipment and materials can be handmade to save cost.

Smith (1995) and Hiebert (1998) have identified the following as the basic things that can be used in forming handmade sheets: Beaters, pulp, vats, sizing, moulds and deckles, felts, presses, dryers and colours.

1. Beaters: Are used to reduce fibres into pulp. Smith (1995) admits that it is an excellent idea for an instructor of pulp art to have an access to a Hollander beater, which can reduce fibres to any consistency of pulp depending on what the pulp would be used for, reducing the load involved in pulping. With the absence of the Hollander beater, both Smith (1995) and Heibert (1998) advocate the use of an older blender and also hand beating with wooden paddles on a hard surface. Heibert expresses that hand beating is particularly suitable for working with small amount of fibres. Although labour intensive, it draws out the fibres leaving them long, strong, and firm. In determining whether the fibre is done, an instructor can put a pinch of the beaten pulp in a jar almost full of water and shake it up. After shaking if there are clumps and strings of fibre then the fibre needs to be beaten a bit longer. But if the fibres do not bundle but rather looks very fine and uniform then the pulp is done and ready to use. Smith (1995) cautions that the length of beating time greatly affects the outcome of the finished sheets. The longer a fibre is beaten, the stronger and crisper the sheets that will be produced; also, long-beaten pulps drain more slowly and shrink more when it dries.
2. Pulp: After beating raw materials the end result is what is known as pulp. Pulp can be refrigerated or rinsed very thoroughly intermittently to prolong its life span. Unrefrigerated pulp, according to Smith (1995), should last at least a week, depending on the amount of warmth in the storage room. The change of smell in pulp gives the indication that the pulp is going bad.
3. Vats: These are containers that are used to hold water and pulp before sheet formation. Smith (1995) advises that, for a classroom use, rubber containers with handles and

sealable lids, having openings larger than the moulds and deckles to be used are appropriate and ideal for instructors. Plastic containers with handles and sealable lids are appropriate because during the teaching sessions the containers can be moved from one place to another and also when the room where the project will take place happens to be used for other activities, at the end of every teaching session the lids of the containers can be quickly snapped on and moved off to another place within a short time to give way for other activities.

4. Sizing: Sizing is the substance added to coat pulps to make them more water repellent and bleed resistant. This is, done to ensure that drawing, writing, painting and printing can be done on the sheets smoothly. That is depending on the use of the sheets, one may or may not choose to add sizing to the pulp. Sizing can be done both internally and externally during papermaking. Internal sizing is done when the size is added to the pulp before the sheets are formed. The external sizing is also done by dipping the sheets in the size after the sheets are dried. Smith (1995) recommends internal sizing for instructors because it is the easiest procedure of the two. Examples of sizes that instructors can use in the classroom are liquid laundry starch or corn starch.
5. Moulds and deckles: Mould is a screen covered frame and deckle is an open frame placed on top of the mould to define the edges of the pulp on the screen. For beginners in pulp art and young students, Smith (1995) sees it to be best for instructors to allow their participants to use found moulds in the form of old metal and plastic items like cookie cutters with backs, candy moulds, bread and cake pans, in place of the conventional mould and deckle. For large classes where many moulds are needed, it will cost less to use found moulds which are mostly smaller than the average mould and deckle, requiring

less storage space while drying. Furthermore, Arrowood and Brewes (1990) comment that, for young students, the use of candy moulds and cookie cutters will be fun and easy to use; and found moulds also create avenues for casting three dimensional sculptural works with the pulp.

6. Felts: Felt is the term for a fabric on which a freshly made sheet from the mould is transferred onto. The surface of felts makes imprints on the surface of fresh sheets, so instructors can choose to use felts with interesting textures which will be transferred onto the sheets (Smith 1995 and Hiebert 1998). Farnsworth (1989) argues that a felt or absorbent material used in sheet formation is not a good idea, because absorbent materials tend to pull the water necessary for sheet transfer away from the mould, hence couching on a very flat smooth surface must be encouraged. Couching is to transfer a freshly made sheet of paper from a mould onto another surface.
7. Presses: A press in papermaking is simply something that removes water from the wet sheets that are formed from the pulps and compacts the fibres tightly together as they bond. After pressing, the sheets are still wet and not dry. Since the presser is basically to drain the water out of the sheets, instructors are advised to use any convenient style, procedure or any available equipment that can drain water out of wet sheets.
8. Dryers: Hiebert (1998) recommends starting very simple and adds that there is no need to invest in an elaborate drying system. Some things an instructor can consider when choosing a drying system can be climate, space and how instructors would want dried sheets to look. The sheets can be hung on drying lines, they can be laid out to dry on a table and they can also be brushed onto boards or walls, or the instructor can set up a drying system to dry the wet sheets. Each of the drying methods affects the texture of the

sheets, so instructors can experiment with the various types of drying to see which one they prefer.

9. Colours: In choosing colours for pulps Heibert (1998) cautions instructors to consider the following factors: Colours for pulps should be durable and must not rub off when touched; colours must not lead to the deterioration of end products; and colours that can fade off after long-term exposure to light must not be used. Smith explains that pigments are insoluble particles which when added to most pulps, do not naturally fix to the pulp, because pulps and pigments have the same charge ability and repel each other. This situation can be dealt with by adding a chemical known as retention aid which has an opposite charge ability to the pulp and the pigment. When pigmenting is done properly, the pulp should be able to take the colour of the pigment and the water in which the pulp is floating must also appear very clear. After pigmenting, if the water in which the pulp is floating does not become clear, then the retention aid might not be enough or the pigment is too much for the pulp.

In order to prevent the above situation from occurring, instructors can start with additives in small quantities and add them in bits. Hiebert (1998) also points out that, some sizing chemicals are able to charge pulps and act as retention agents themselves, so an instructor may not need additional retention aid if he or she uses a size. If it is important that a specific colour must be obtained for a specific work, a sample of the coloured pulp must be dried to see the final colour before using it. Once the pulp is properly pigmented, rubber gloves will not be necessary or needed when working with the pulp because the pigment adheres to the pulp rather than the skin, this means properly pigmented pulps are safe to work with using bare hands.

Dyes, unlike pigments, are soluble substances that penetrate through the pulp easily which allows for the pulp to take the colour of the dye. Because dyes easily fade off when exposed to light and the fact that their toxicity level is very high Smith (1995) prefers not to use dyes in working but suggests that instructors can experiment with various water soluble colours to know the ones that best work for them.

The equipment and materials mentioned and discussed here could help in executing the practical aspect of hand papermaking depending on the individual's choice between expensive and inexpensive equipment and materials that are available for use. Figures 1-7 illustrate the equipment discussed by Smith and Hiebert while figure 8 shows methods of drying handmade papers on Page 22-24.



OUTLINE DRAWINGS OF EQUIPMENT DISCUSSED BY SMITH (1995) HIEBERT (1998)

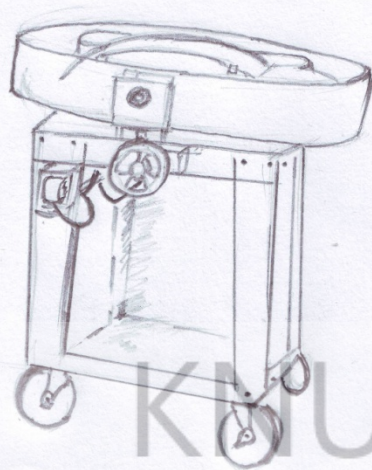


Fig. 1: HOLLANDER BEATER



Fig 2: BLENDER

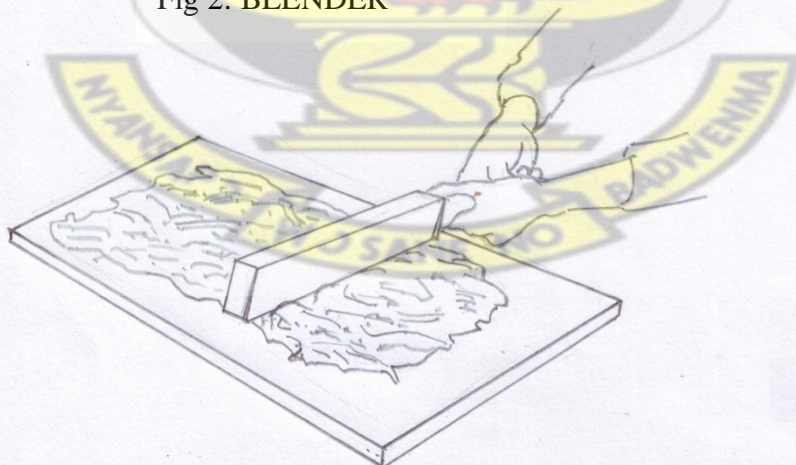


Fig 3: HAND BEATING WITH A WOODEN PADDLE



Fig 4: VATS

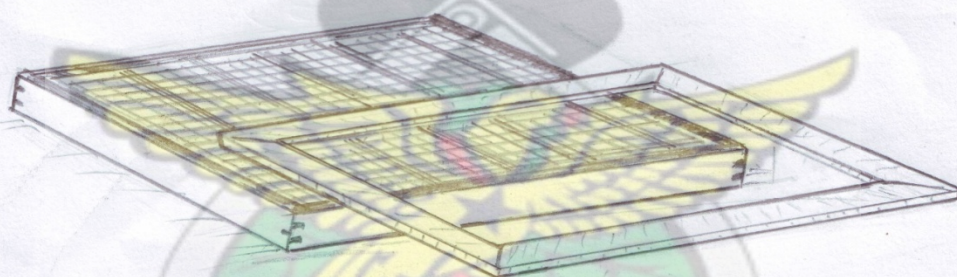


Fig 5: MOULD AND DECKLE

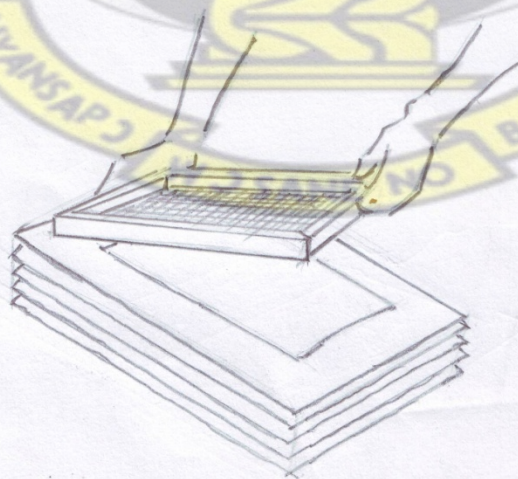


Fig 6: A PACK OF FELTS

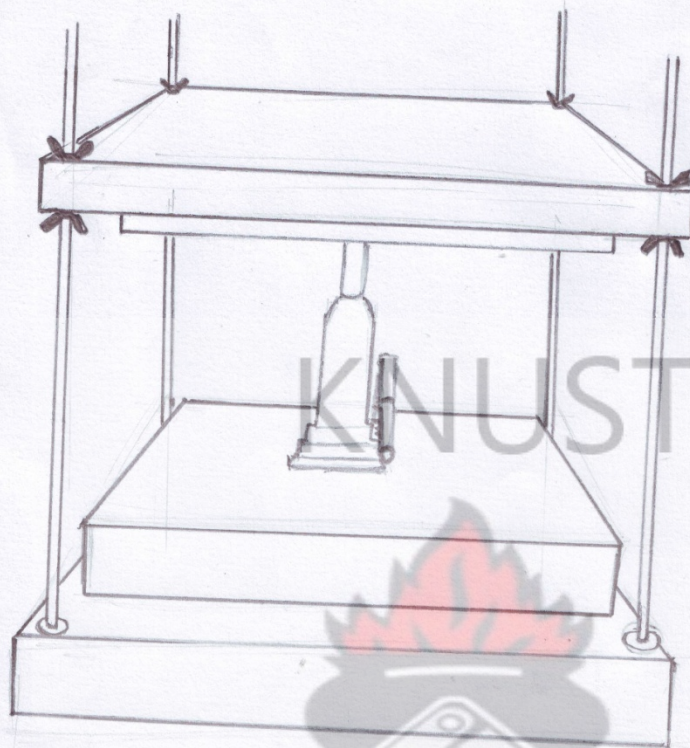


Fig 7: A PRESS

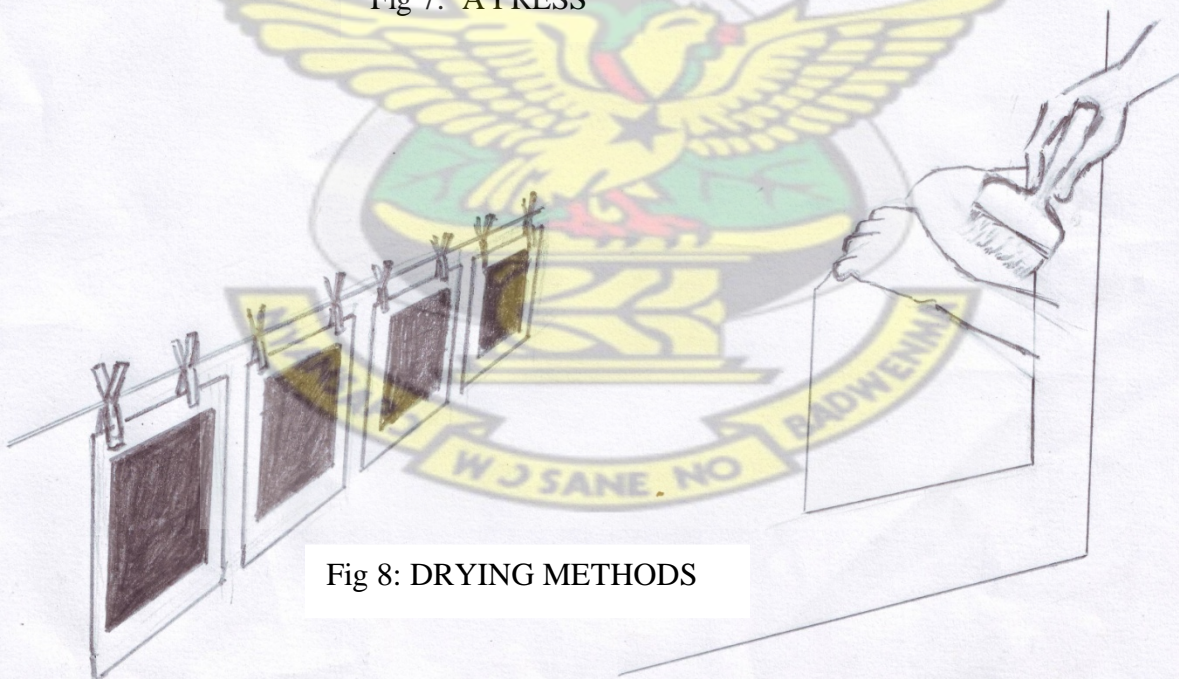


Fig 8: DRYING METHODS

2.9 Papermaking Organisations That Recycle

Martinson (2000) talks about WomanCraft, a non-governmental organisation in North America that trains homeless women in papermaking. WomanCraft is an economically run, true recycling organisation. This has helped reduce pressure on the use of fresh resources, keeping start-up costs extremely low. Dried flowers used for some of their sheets are leftover from floral shops. The workers at WomanCraft pick up the leftover flowers, dry and sort the various colours according to plant type. No sizing substance is added to the pulps from especially recycled commercial papers because they already contain a lot.

From very simple equipment and materials like kitchen blenders, bed sheets, tables, moulds and deckles, artists at WomanCraft have developed a successful line of paper products from mainly recycled materials for sale. Their products include envelopes, writing papers, note cards, gift bags, simple books and journals. Although there are a lot of machine-made paper products today, WomanCraft is confident that their items are sufficiently different to make consumers to continue to patronise their products. At WomanCraft both waste products and homeless women are given a chance for a new beginning.

According to Provideo (2010), the Philippines produces around 54,700 metric tons of a plant known as *durian* annually. The flesh and seeds make up around 60 percent of the fruit, while the husk or skin which is generally considered waste material represents 40 percent or 21,880 metric tons. Hence, every year around 22,000 metric tons of durian husk are generated, which usually end up in the garbage dumps or along roadsides to rot. A women's organisation known as KATAKUS in Panabo City, Philippines, upon realising that the durian husk can be recycled, now utilises the husks as one of their raw materials in making handmade paper. Through a training that was conducted in papermaking for KATAKUS in 1994, the organisation learnt the technology on the production of handmade paper, which they practise using banana, abaca and durian waste fibres. KATAKUS products made from durian paper such as lamps, paper bags, scrapbooks, and photo albums are more popular among customers due to their attractive natural colours and texture. Throughout its existence of more than a decade, KATAKUS has not only provided its members with income, but more importantly, it has boosted the self-confidence of the members as productive citizens. KATAKUS members, by working in the handmade paper project, are able to support themselves and their families.

This indicates that income-generating organizations are using waste materials in making useful handmade paper products. This is exactly the intent of this project, which is to use waste fabrics to create useful products which hitherto, would have ended up in landfill sites. Also the idea of creating jobs for individual people also gives a boost to the need and importance of this project.

2.10 Organising and Teaching Hand Papermaking

Basic Processes Involved in Hand Papermaking:

According to Hiebert (1998), the following are the basic process involved in hand papermaking:

1. First, raw material is obtained (papermaking fibre) by harvesting plant material or purchasing fibre from a papermaking supplier.
2. Once the fibre is obtained it is processed; the processing varies from fibre to fibre but most plant fibres require cooking.
3. All processed and cooked fibres are beaten into pulp, using methods such as hand beating, a blender, or beating in a Hollander beater.
4. After beating, the pulp is mixed with water in a vat.
5. A mould and deckle is then dip in and out of the vat of pulp, allowing the pulp to settle on the screened surface of the mould as the water drains through the holes in the screen. With this the deckle is removed and the mould is tilted to let the excess water drain off.
6. The wet sheet on the mould is then transferred onto a felt or blanket. Multiple sheets of paper one on top of the other, can be couched together each separated by a layer of felt or blanket.
7. The couched sheets are pressed to remove water from the wet sheets.
8. The pressed sheets are dried using a box fan or sunshine.

There are many advocacies for how to organise and train people in papermaking. Smith's (1995) view on how the process of papermaking can be organised and taught successfully is that there are as many techniques as there are different kinds of teachers. There is no single right way to organise and teach any kind of pulp art except that in teaching papermaking, the instructor must introduce the concept of pulp art slowly to the audience one is handling. Smith continues that there are many steps in making a piece of paper and students can only grasp so much at a time. With this, the process must always be broken down into as many steps as possible to allow students to be able to assimilate all that they are being taught. The first day can be on pulp preparation and the next day can be for working with the pulp. Ideally, it will take students several practices before they can use the pulp as an art medium.

Concerning the organisation of a classroom for such projects, the class should be arranged to suit the needs of the project, all materials and tools needed must be present for a

smooth operation. Depending on the number of students and the class size, the tools, materials and equipment must be arranged carefully and very well to allow space and easy movement in the room. Smith (1995) has tried arranging rooms for papermaking projects in many ways and says the arrangement that works best for her is to have tables in the middle of the room for supplies of materials and to surround them with student work tables, where two or three vats of pulp are placed on each of the student's working tables and all other equipment and materials on the supply tables. Chairs are placed along the walls of the room, and if need be to restore order in the room, participants are directed to sit on them. If the time for training is limited, instructors can complete some of the initial process before the participants arrive, that is, the instructor can prepare the different kinds of pulps to be used for the project and can even make samples of what he or she is going to teach the participants before the start of the class. This does not mean the participants will not be taught how to prepare the right consistency of pulps for creating the different kinds of works. Smith states it very clearly that if students are not involved in the preparation of the pulp, the process must be explained to them, through a brief demonstration during the teaching session.

Because of the many processes involved in papermaking, it is advisable for a teacher taking people through papermaking to have one or two volunteers or teaching assistants who will help the main teacher to carry out the project. This allows for orderliness and also ensures that all participants participate fully throughout the process. In the case of teachers who do not have volunteers to help them during the training sessions, students who are able to grasp the process and finish with their works early can be asked to help and assist other students who will still be working.

Smith (1995) states that the value of any pulp art process is much more important than the products that can be created and further cautions teachers against being too product-oriented at the outset. To keep the papermaking project more manageable with any number of participants, Smith recommends that smaller works should be made because bigger works require more pulp, more drying space, and more drying time, which can all create problems, implying that teachers must not set themselves up for something they cannot handle. From another angle, Radolan (2004) expresses that one of the most exciting things about teaching hand papermaking is that it often provides many new learning experiences.

Work Space:

Radolan (2006) sees a well designed and equipped classroom or studio as appropriate for papermaking, with a papermaker or educator's dream space, complete with a beater, sinks, vat tables, a press, drying rack, tables, counters and storage space as a treat for papermaking workshops. As Smith (1995) stresses, in organising a papermaking workshop, instructors can complete some of the initial process like preparation of pulps before the arrival of participants to save time. Radolan (2006) also acknowledges that anyone who enjoys making paper from their

garden plants is well aware of how labour intensive the process is, so in organising a papermaking workshop, it will be wise for an instructor to do most of the labour intensive and time consuming processes like fibre harvesting, preparation, and cooking of fibres before the start of the workshop.

Starting the Workshop:

In contrast with what Smith (2005) shares on how to start a papermaking workshop, Radolan normally starts her workshops by introducing the participants to a brief history of the craft of hand papermaking, and follows up with pulp preparation and then working with the pulp (Radolan, 2003, 2005, 2010). Radolan also engages the help of teaching assistants to help her run papermaking workshops.

Safety Measures:

Aside the basic procedures Smith (1995) and Radolan (2003, 2005, 2006, 2010) have suggested, Vickerman (1995) also hammers on the safety measures that instructors must note in organising and teaching any kind of pulp art. Manipulating pulps to create art is fun for all ages but instructors must always adopt the 'safety first' motto. There are some hazards in working with some plant pulps which instructors, especially instructors of children, must know in order to protect participants. Some wood and plant materials can cause allergic reactions and skin irritations to some individuals. Schutter (1998) confirms this by stressing that pulp spraying, which is spraying pulp on three dimensional moulds to attain the form of the mould with the pulp may be harmful, especially to those with pre-existing respiratory conditions. According to Schutter (1998), pulp spraying could cause some people to cough and sneeze within seconds of entering the papermaking workshop. Vickerman (1995) states that soda ash and caustic soda which are added to fibres during cooking are highly corrosive upon skin and eye contact and inhalation. Chlorine bleach which is added to pulp to whiten it and other colouring pigments must be handled carefully by instructors because they can cause skin, eye and respiratory irritation.

The blades in mechanical beaters can trap the hands when working with it or when cleaning the pulp out of it so care must be taken when working with the beater. Instructors must especially guide their participants on the use of mechanical beaters during pulp art projects. The use of large amounts of water used in papermaking workshops also presents hazards if splashed on electrical outlets or on other electrical equipment around. Farnsworth (1989) adds that to prevent cracking effects on the hands during cooking and rinsing of fibres, protective gloves can be worn. Vickerman (1995) advocates for instructors to prevent situations of electricity coming in contact with water when working. Hiebert (1998) also mentions that instructors must make sure their working area is free of all electrical hazards and that all extension cords must be kept well above the working floor and far away from water during working hours. Vickerman (1995) and Hiebert (1998) add that hand papermaking projects must be organised in a well ventilated

room or area; the instructor must also bear in mind that beating can be done anywhere, just that the noise the pounding and blending creates can disturb other people around the place.

Benefits and Opportunities Offered in Pulp Art:

Aside this, Vickerman (1995) confirms that pulp art provides opportunities to introduce some basic chemistry and environmental issues to learners and also offers artistic possibilities limited only by the imagination of the pulp artist. Hiebert (1998) also insists that for an instructor to organise a papermaking project, the instructor must have a general understanding of the entire process involved in the craft.

2.11 The Need for Teachers to Inculcate the Recycling Attitude in Students

Texly (1990) talks about the role of the classroom teacher in the throw-away society one finds himself in and how teachers can help educate and promote recycling of waste products. Throughout history, waste has been a problem, and with societies turning into throw-away societies, the problem has grown into crisis. Some solutions to this problem are recycling resources and reusing materials but before these solutions can be carried out, they require fundamental changes in institutional policies and individual behaviours.

Educators and educational institutions are always called upon to take up and address issues when behavioural changes are needed; and the waste crisis is no exception. Educators must add a fourth “R” (recycling) to the traditional three “Rs” of reading, ‘riting and ‘rithmetic. Some teachers are already teaching recycling in their schools but just teaching about recycling in the classroom will not initiate the attitudinal and behavioural changes required to solve the waste crisis. Teachers must practise what they teach with their students. Educators all over must practise recycling, reducing and reusing with their students to encourage positive behaviours of waste management in them.

A school recycling programme of waste products may not necessarily make money but can cut down on waste and disposal costs and also instill positive behaviours associated with conserving natural resources. When educators take up recycling in this form, the school will end up teaching the society examples they should follow.

Bullman (2007) reports that our schools possess a unique opportunity to form the behaviours of people during the earliest stages of development through adolescence. The school is the learning environment where children learn the behaviours they will adopt for their lifetimes, hence it is a perfect place to initiate the habit of recycling.

School recycling programmes offer the opportunity to educate on proper waste reduction practices, and inculcate a sense of leadership and responsibility in young people. Recycling as much material as possible also helps to extend the life of local landfills. Implementing school recycling programmes also supports lessons on environmental stewardship and conservation taught in science and social studies. By implementing recycling programmes, schools become a hands-on learning environment where students learn to practise the behaviours of environmental stewardship and good citizenship by reducing waste.

Making a school recycling programme is not difficult, kids naturally enjoy recycling programmes when they are involved with collection and making sure everything runs smoothly. Young people respond amazingly well to having a job responsibility and performing it if they believe they are doing a good thing. It is good for communities, if future leaders learn the recycling habit, which they will carry over into their homes and on into adulthood (Association of New Jersey Recyclers, 1994). This underscores the importance of this study of hand papermaking which also seeks to raise Ghanaian teachers' consciousness about recycling through papermaking.

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CHAPTER THREE METHODOLOGY

3.1 Overview

The chapter outlines the methods and procedures used in the study to achieve its objectives. These include detailed information on the research approach and design, data collection instruments, population for the study, step-by-step procedures followed in the project and actions taken by participants.

3.2 Research Design

The qualitative research approach was used in this study. Hancock (1998) explains that qualitative research is concerned with developing explanations of social phenomena. That is to say, it aims to help understand the world in which one lives and why things are the way they are. *Malterud (2001) adds that qualitative research methods involve the systematic collection, organisation, and interpretation of textual material derived from talk or observation. It is used in the exploration of meanings of social phenomena as experienced by individuals themselves, in their natural context.*

Experimental, descriptive and action research methods were also used for the study. Beaumont (2009) explains that experimental research designs offer the best method available to researchers to be able to investigate causality due to the high degree of control. Experimental research was adopted in this research because of the following reasons:

- a) It provides opportunity to actively influence something to observe the consequences.
- b) The method helps improve one's everyday life.
- c) The method offers a higher degree of control.

Experimental research was used to identify waste fabrics which combined with the paper mulberry bark could make good and useful sheets. It also enabled the researcher to assess the viability of six painting and drawing mediums on the resulting papers produced to find out how the sheets reacted to the different mediums.

Descriptive Research:

Key (1997) states that descriptive research is used to obtain information concerning the current status of a phenomena to describe "what exists" with respect to variables or conditions in a situation. The descriptive research method was employed because:

- a) It helps to identify the attributes of a situation or process based on observation.
- b) It assists researchers in observing the natural relationship that exists in events, behaviours and situations.
- c) It creates avenue for researchers to give a step-by-step account of procedures followed in projects.

Descriptive method was used in the step-by-step explanation of the procedures the researcher used in making the sample sheets from the waste fabrics combined with paper mulberry. Description was used in analysing the qualities of the sheets that were produced, and how the sheets reacted to the six painting and colouring mediums. In addition, feedback from teacher participants were also described and analysed as part of the data collected.

Action Research:

Somekh (2008) also points out that action research is a research methodology uniquely suited to researching and supporting change. It integrates social research with exploratory action to promote development. Action research was used because of the following reasons:

- a) It offered the opportunity to bring concerned individuals on board to address the problem of waste recycling.
- b) The involvement of concerned individuals in addressing the problem of waste recycling provided more information about the situation at hand.
- c) Understanding of the need for recycling was widely shared with participants.
- d) Participants learned best and were more willing to apply what they had learnt.

Action research was used to bring selected art teachers together to address the need for introducing the art of recycling in to Ghanaian schools. Teachers were introduced to the outcome

of the sheets and works the researcher had made from waste fabrics combined with paper mulberry and also the procedures followed to arrive at the sheets.

3.3 Library Research

The following libraries were used for the study:

- a) Art Education library, College of Art and Social Sciences, KNUST, Kumasi.
- b) College of Art and Social Sciences' Library, KNUST, Kumasi.
- c) Main Library KNUST, Kumasi.

3.4 Population for the Study

Yount (2006) asserts that a population consists of all the subjects you want to study that comprises all the possible cases (persons, objects, events) that constitute a known whole. A homogenous population of Visual Arts teachers were studied. The target population was made up of Primary, Junior and Senior High School art teachers in the Kumasi metropolis. The accessible population was made up of six Primary, seven Junior High and seven Senior High schools in the Kumasi metropolis. Taylor-Powell (1998) also claims that a sample is a portion or a subgroup of a larger group called a population. Yount (2006) affirms that sampling is the process of selecting a group of subjects for a study in such a way that the individuals represent the larger group from which they were selected.

A sample of convenience is the terminology used to describe a sample in which elements have been selected from the target population on the basis of their accessibility or convenience to the researcher (UNESCO International Institute for Educational Planning 2010). Marshall (1996) includes that convenience sampling involves the selection of the most accessible subjects. It is the least costly to the researcher, in terms of time, effort and money. According to Ross (2002), purposive sampling involves selecting members from a population to comprise a sample because they possess specific attributes of interest that address the purpose of a particular research problem under investigation.

With respect to the explanations given above, convenience sampling of 20 schools in Kumasi that could be easily accessed in terms of time and money were selected; to include six Primary, seven Junior High (JHS) and seven Senior High Schools (SHS). From the 20 schools, purposive sampling was used to select one art teacher from each of the schools to attend the workshop. Purposive sampling was appropriate for this project because it helped to reduce disappointments and absenteeism by the participants in attending the workshop; the researcher made sure participants that were selected were those who would make time for the workshop.

Three of the selected schools had art teachers who were also students of the same department at KNUST as the researcher and so were given invitation letters (see Appendix A) to represent their schools at the workshop. The remaining 17 invitation letters were sent to heads of the selected schools and heads of the respective art departments, each of which appointed an art teacher to attend the workshop. Details of the participants who attended the workshop are shown in Table 3.1.

Table 3.1: Representation of Participants Who Attended the Workshop

Nº of participants who attended the workshop	Nº from Primary School	Nº from JHS	Nº from SHS	Nº of female participants	Nº of male participants	Years of teaching experience
15	5	4	6	3	12	Ranged from 3 to 30 years

3.5 Data Collection Instruments

Two data collection instruments were used for the study; these are participant observation and interviews. Kumekpor (2002) expresses that participant observation involves the idea of the researcher being both a spectator and an actor at the same time when observing and recording information. In this regard, the researcher assumed the role of an active participant and a researcher at the same time to collect data on hand papermaking. Participant observation was decided upon because of the following reasons:

- a) It helped the researcher to know how things work in her chosen area of research.
- b) Provided information previously unknown to the researcher.

Interview is a conversational practice where knowledge is produced through the interaction between an interviewer and an interviewee or a group of interviewees (Brinkmann, 2008). Interview was decided upon because of the following reasons:

- a) It enabled the researcher to do a group interview with participants at the workshop.
- b) It made it possible for the researcher to obtain information from participants who introduced what they acquired at the workshop to their students.

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3.6 Types of Data

3.6.1 Primary data

Primary data for the project was collected through participant observation where the researcher with two experts in hand papermaking worked together on projects and interviews with the teachers who were participants of the workshop organised by the researcher.

3.6.2 Secondary data

Secondary data for the project constituted all data collected from books, articles, internet and other literary sources.

3.7 Data Collection Procedures

Data were collected through participant observation where the researcher worked with two specialists in hand papermaking from 15th July through to 10th August 2010 at the Textiles Department College of Art and Social Sciences, KNUST Kumasi. During this period the researcher recorded new ideas and techniques in hand papermaking which informed the execution of the experiments for the project described in this report. Data were also collected through a group interview during the papermaking workshop for the selected art teachers. At this point, a question-based interview was conducted with the participants. This was done by the researcher posing questions to the participants and recording their responses. The recorded information was later retrieved and analysed. (Appendix B shows the question-based interview guide).

Furthermore, an in-person interview was also used to collect data from participants who introduced the recycling papermaking experience to their students. Clark (2008) buttresses this point as he explains that an in-person interview is a data collection method where the researcher is in the same location as the participant and asks questions to which the participant responds. In view of this the researcher went to the various schools of the participants with a question-based interview guide and sought for perceptions and experiences about the papermaking process. The

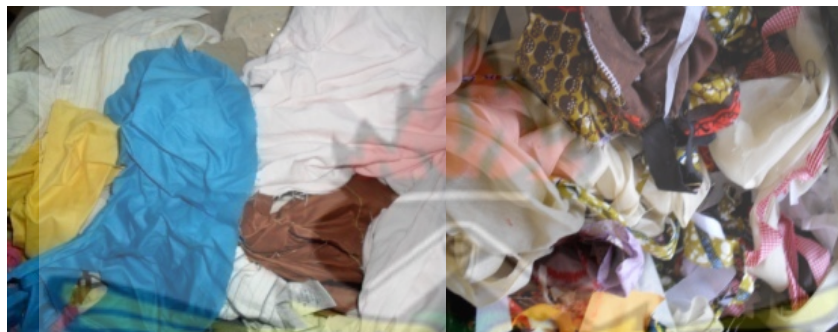
outlined questions were posed to the participants one after the other, while the researcher wrote the responses. The responses from the participants were later discussed and analysed. See Appendix C for the outlined questions for the in-person interview.

3.8 Procedures Followed in the Project

Step 1: Preparation of Waste Fabric

The researcher collected lots of waste fabrics (Plate 3.1) from the floors of dressmakers and also old clothes that were not being used anymore from friends. The collected fabrics were sorted out and six categories of fabric types were obtained. These were: linen, cotton, polyester, nylon, wool and acetate fabric contents. Each of the six types of fabrics was cut into smaller pieces as shown in Plate 3.2.

Collected



**Plate 3.1:
waste fabrics**

pieces of



**Plate 3.2: Cut
waste fabrics**

Step 2: Harvesting of paper mulberry plants

This involved assisted visits to the Abofoc forest on the Kumasi-Techiman highway identifying the plants and harvesting them as shown in Plate 3.3.

3.3: Harvesting paper mulberry Abofoc, Ashanti Region



Plate of at

Step 3: Procedures Followed in the First Cooking of Paper Mulberry Fibre

After harvesting the plants, preparations to get them ready for pulping began as illustrated in Plates 3.4 - 3.12. The inner bark of the mulberry plant is what was needed for this project so while the harvested plant was still fresh, both the inner and outer bark of the fibre were stripped from the woody part of the plant and cooked twice. With the first cooking, some amount of the removed fibre were cut into pieces and placed in a bowl with some amount of water and a cup full of caustic soda added to it and cooked for two hours. After the two hours of cooking, a piece of the fibre was picked and tested to see if it was soft enough for pulping by pulling it apart. The pulling was easily done and this was an indication that the fibres were soft enough for pulping. At this stage the fibres were removed from the cooking pan and the outer bark of the fibre was cleaned off the inner bark. After obtaining only the inner bark, the fibre was further cleaned in water to get rid of all traces of the caustic soda.

Pictures of Procedures Followed in the First Cooking



Plate 3.4: Freshly harvested paper mulberry



Plate 3.5: Outer bark of the paper mulberry plant



Plate 3.6: Inner bark of the paper mulberry plant

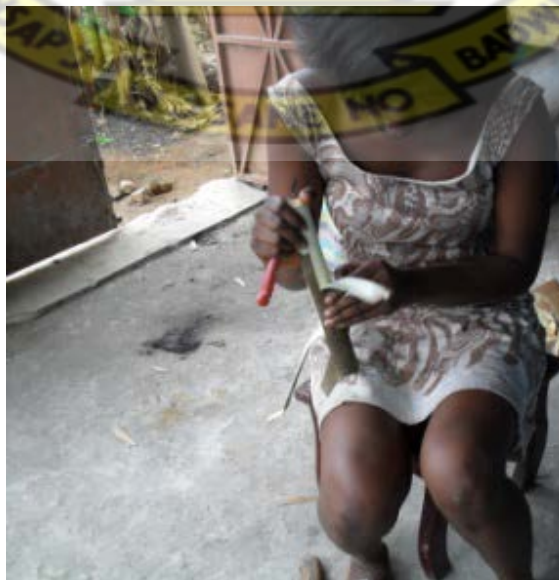


Plate 3.7: Stripping inner and outer bark fibres from the mulberry wood



Plate 3.8: Cutting stripped fibre into pieces for cooking



Plate 3.9: Cooking fibre with caustic soda on open fire



Plate 3.10: Cleaning outer bark to get the inner bark fibres



Plate 3.11: Cleaned inner bark of the fibres in clean water



Plate 3.12: Cleaned inner fibres of mulberry plant

Step 4: Procedures Followed in the Second Cooking

With regard to the second cooking, the researcher weighed one pound of the mulberry fibres as shown in Plate 3.13, added 160 grammes of caustic soda (Plate 3.14), then 18 litres of water and cooked it for two hours (Plate 3.15). After two hours of cooking, a piece of the fibre was tested

by pulling it apart (Plate 3.16), but this time the fibre did not pull easily so another 160 grammes of caustic soda was added to the cooking fibres (Plate 3.17) and left to cook for another one hour. After three hours of cooking, another pulling test was done and this time, the pulling was done with ease, so the fibres were removed from the cooking pan and the fire was put out with water. The outer barks of the fibres were then removed to obtain the inner bark.

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Pictures of Procedures Followed in the Second Cooking



Plate 3.13: Weighing the mulberry fibres



Plate 3.14: 160 grammes of caustic soda



Plate 3.15: Cooking fibre with caustic soda

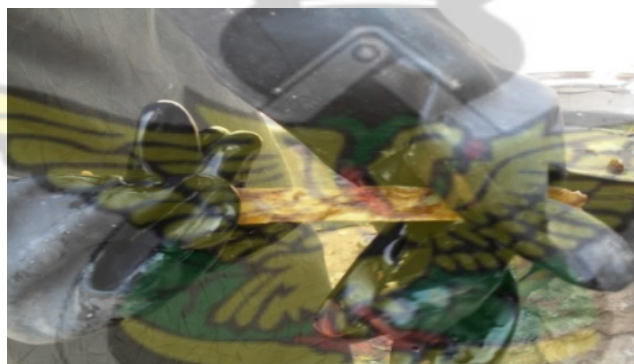


Plate 3.16: Fibre unable to pull apart easily after two hours of cooking



Plate 3.17: Adding another 160 grammes of caustic soda



Plate 3.18: Cleaning the cooked fibres

Step 5: Pulping and Identification Processes

The prepared inner bark of the mulberry plant was also cut into smaller pieces. The researcher used an electric blender to pulp this by first filling the blender with 1.5 litres of water for each pulping session. In combining the fabrics and the mulberry fibres for pulping, the researcher used the ratio of 70% fabric to 30% inner mulberry fibres for each of the six fabric types; this was to ensure the use of more of the waste fabrics since the research was focused on recycling. This was modelled after the workshop the researcher took part from 15th July to 10th August 2010 at the Textiles Department of KNUST on hand papermaking where she was made aware of the fact that pulps that are likely to produce good quality handmade paper are those which can be held up after couching when the sheet is still wet without it falling apart. With this in mind, the researcher took the six different fabric pulps through the process mentioned above to determine the fabrics that could produce useful papers.

In doing this, the researcher filled a plastic pan with 25 litres of water and poured a combination of linen and mulberry inner bark pulp into the water, and then shook the mixture with her hand to obtain an even consistency after which a mould and deckle was used to scoop some of the pulp onto the mould. The pulp on the mould was then couched on a felt placed on a flat wood, and while the sheet was still wet, the researcher removed the wet sheet with her hands from the felt and held it up to see if the pulp would fall apart or not. The remaining five pulps were all taken through the same process. All the six wet sheets did not fall apart when they were removed from the felt and held up. This meant that all six wet sheets had the potential of

producing good quality handmade papers. Plates 3.19 – 3.26 illustrate the processes described above.

**Plate
mulberry fibre into**



**3.19: Cutting inner
pieces**



Plate 3.20: Pulping process for linen and mulberry

Pictures of the Identification Processes



7

8

9

Plate 3.21: Identification process for linen



Plate 3.22: Identification process for cotton



Plate 3.23: Identification process for nylon



Plate 3.24: Identification process for polyester



Plate 3.25: Identification process for wool



Plate 3.26: Identification process for acetate

Step 6: Production of Dried Handmade Papers

Because all six wet sheets exhibited good potentials to form good quality papers, dried sheets were produced out of each of the six fabrics in combination with paper mulberry bark to see their outcome. This was done by starting with the same procedure used for the identification of the fabrics but this time after couching two wet sheets, a felt was placed on the wet sheets, and another two wet sheets couched on the felt. This was repeated until a good number of sheets were couched and a flat wooden board was placed on the couched sheets and pressed with G-clamps. The pressed sheets were then removed from the felt and placed onto flat metal plates where a brush was used to remove air bubbles that were created by the sheets on the metal plates. After this the sheets were dried in sunshine. See Plates 3.27 – Plates 3.31 for pictures on the production of dried papers from fabrics and paper mulberry.

Production of Dried Sheets from the Fabrics and Paper Mulberry



Plate 3.27: Preparing wet sheets for pressing



Plate 3.28: Pressing wet sheets with G clamps



Plate 3.29: Removing pressed sheets from felts onto metal plates



Plate 3.30: Removing air bubbles from pressed sheets

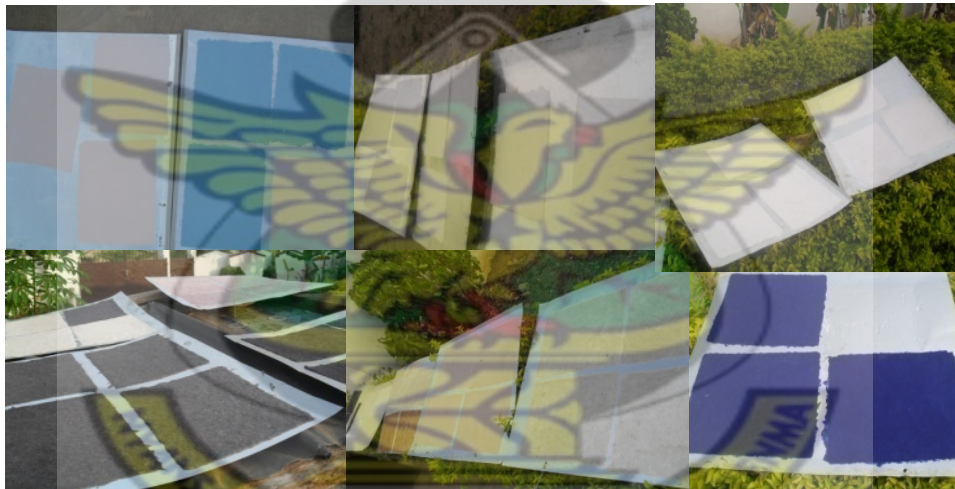


Plate 3.31: Drying sheets on metal plates

Step 7: Testing Drawing and Painting Mediums on Papers and Making of

Miniature Books

The researcher tested six different painting and drawing mediums on the dried sheets to see how the sheets would react to them, and the qualities that the painting and drawing mediums would exhibit. The mediums were colour pencil, watercolour, pastel, poster colour, acrylic and oil paint. After that, the researcher used the dried sheets to produce miniature books to find out how suitable the sheets would be in the form of books that could be written in. See Plates 3.32

and 3.33 for the results. Making the books required thread, needle, rule, scissors, clips, awl, bone folder and a cutter. A ruler was used to take measurements, the bone folder was used to make correct folds and the clips were used to hold the sheets together. The awl was used to create holes; the scissors and the cutter were both used in cutting sheets and thread. The needle and thread were used to sew the sheets together. See Appendix D for samples of handmade papers.

Testing of Drawing and Painting Mediums



Plate 3.32: Testing painting and drawing mediums on dried sheets

Making of Miniature Books



Plate

3.33: Researcher making miniature books from the dried sheets

Step 8: Organizing of Workshop

The researcher organised a workshop for selected art teachers in the Kumasi metropolis at the Textiles Department of Faculty of Art, KNUST, where the teachers were introduced to the process of hand papermaking. This was done to kindle the interest of the teachers to start practical recycling activities in their schools to help their students understand the need for recycling waste. There were 15 participants although 20 teachers were expected to attend the workshop. The workshop started at 10: 30 am and ended at 3: 30 pm on 27th November 2010.

At the commencement of the workshop, the researcher gave an introduction on what the workshop was about. This included information on the paper mulberry plant and the idea of combining it with waste fabrics to make useful sheets of papers. The researcher also showed to the teachers the sheets and art works she had produced out of the mulberry plant and the waste fabrics. The researcher then took the teachers through the same processes described in Steps 1- 7.

After the papermaking process, the researcher asked the teachers to test different painting and drawing mediums on the dried handmade sheets. The researcher also taught the teachers how to make miniature books out of the dried sheets. Participants were not necessarily taught how to use the painting and drawing mediums on the sheets because all the participants were artists so they were encouraged to explore on their own. The workshop was concluded with the researcher asking the participants' to evaluate the workshop and to talk about the need for recycling in general. This was based on the interview guide shown in Appendix B.

After the discussion, the researcher informed the teachers that she would visit them to find out what they would do with their students upon gaining the knowledge provided through the workshop. See Plates 3.34 - 3.47 for pictures of the workshop.

Pictures of Workshop



Plate 3.34: The researcher introducing participants to the concept of the workshop



Plate 3.35: Researcher taking participants through how to prepare the mulberry plant before pulping



Plate 3.36: Participants practising how to peel inner and outer bark of paper mulberry



Plate 3.37: Researcher showing participants how to clean cooked mulberry



Plate 3.38: Participants practising how to clean paper mulberry



Plate 3.39: Researcher showing participants how to pulp cooked mulberry manually with mortar and pestle



Plate 3.40: Researcher showing participants how to use a blender to pulp waste fabrics and paper mulberry



Plate 3.41: Researcher showing participants how to make sheets



Plate 3.42: Participants practicing how to make sheets



Plate 3.43: Researcher demonstrating a pressing process with both G-clamps and a jack press



Plate 3.44: Demonstrating how to prepare pressed sheets for drying



Plate 3.45: Researcher showing teacher participants how to form miniature books from handmade sheets



Plate 3.46: Teacher participants working on sheets with painting and drawing mediums



Plate 3.47: Group interview time with participants

3.9 Data Analysis Plan

The data collected were assembled, analysed and interpreted; conclusions were drawn and recommendations were made. The presentation and analysis of the research findings are provided in Chapter 4.

CHAPTER FOUR PRESENTATION AND DISCUSSION OF FINDINGS

4.1 Overview

This chapter deals with the presentation and analysis of facts, interpretations and conclusions that were recorded from the experiments, the workshop and the feedbacks that were received from the teachers.

4.2 Presentation of Main Findings

In line with Objective One which was to identify waste fabrics that can be used to produce handmade papers when combined with the paper mulberry bark, the study identified six fabrics that had the ability to produce good quality papers, when they were combined in a test with the paper mulberry inner bark fibre. The six fabrics were linen, cotton, nylon, polyester, wool and acetate that were personally collected from shop floors of tailors and dressmakers in Kumasi and processed. It was easy to do this because such fabric waste is generated by all dressmakers who also have much problem disposing of them. They were therefore happy to have the researcher collect them. This indicates that projects can be sustained as raw materials are easy to come by and at no cost except the effort required to collect them for school art work. Paper mulberry also grows wild in Ashanti Region and can be harvested for use. This is the only material that will require some cost and much effort.

To satisfy Objective Two of the study, which focused on production of paper from the identified waste fabrics and paper mulberry bark, the descriptions offered under Section 3.8 indicate the feasibility of the experiment. One characteristic that was observed from all the dried sheets with the different types of waste fabric content was that the sides that were fixed onto the metal drying plate had a smooth texture, while the part that faced the sun had a rough texture.

It was observed that the dried sheets from the linen and paper mulberry sample were not very crisp but rather felt a little bit mushy and soft to the touch. The creamy-white coloured paper could bend easily when held from one end in mid air. The surface did not appear fibrous but rather looked a little rough. The paper was found to be porous and absorbed water quickly. See Plate: 4.1 for illustration.



Plate 4.1:
mulberry papers

Papers made from cotton produced very thin and

Dried combined linen and

and paper mulberry fibre crisp sheets while the thick

sheets were non-crisp and hard. The paper felt firm and solid to the touch. See illustration in Plate 4.2.



**Plate
and mulberry papers**

4.2: Dried combined cotton

Dried papers from nylon and paper mulberry were found to be very soft and fluffy and the fibre content flaked off easily. The sheets also looked fibrous and the fibre content was inconsistent throughout the paper, some places appeared thicker than others. There were so many loose fibres all over the surface of the paper. The paper looked shiny due to the nylon fibres as seen in Plate 4.3.



**Plate 4.3:
and mulberry papers**

Dried combined nylon

Dried papers from polyester and paper mulberry (Plate 4.4) were very soft with fibre strands of the polyester fabric visibly showing. In addition, there was a loose binding between the individual fibres of the sheet with fibres coming off at the slightest pressure.



Plate 4.4: Dried combined polyester and mulberry papers

Dried papers from wool and paper mulberry fibre (Plate 4.5) produced very thick, soft and non-crispy sheets which looked like a blanket. There were loose fibres on the surface of the paper.



Plate 4.5:
mulberry papers

Dried papers from acetate and 4.6) were very soft and somewhat fluffy.

Dried combined wool and
paper mulberry fibre (Plate



Plate 4.6:
and mulberry papers

Dried combined acetate

Dried papers from a combination of linen, cotton and mulberry fibre (Plate 4.7) were strong and hard.



Plate 4.7:
mulberry papers
The descriptions indicate

Mixture of linen, cotton and
the variety of papers that can

be obtained from the waste fabrics. This indicates that the nature of each type of fabric has some effects on the sheets they generate.

Objective Three was to test different drawing and painting mediums on the produced papers and also create miniature books out of the produced papers. To achieve this, the researcher tested a variety of drawing and painting mediums on each sheet and studied how these reacted on each paper. Reactions that were observed are explained as follows:

Reaction of Linen and Mulberry Papers to Drawing and Painting Mediums – Plates 4.8-4.12 show sample art works.

- **Colour Pencils:** Hard scratches of the colour pencils on the linen sheet made the surface fibre content to peel off. The pencil made deep impressions on the paper for the colours to stand out well. Where the colour pencil impressions were not deep, the colour appeared pale.
- **Watercolour:** The watercolour dried very fast upon application on the linen sheet. This made colour control difficult. The watercolour bled on and through the sheet to an extent that the painted work could be seen on the reverse side of the sheet.
- The appearance of the colour on the finished work looked mouldy and did not look very fresh. The paper surface also wrinkled a little after the drying of the paint and the forms in the painting were not well defined due to the bleeding.
- **Pastel:** The application of pastel on the linen sheet resulted in peeling off of the fibre content on the surface of the sheet. The peeling off did not allow good control over the pastel sticks which resulted in the invisibility of the features of the pineapple. In addition, the sheet with the pastel work felt softer than before.
- **Oil and Acrylic paint:** Both oil and acrylic paints bled through the reverse of the linen sheet but slightly. The freshness and warmth of both colours was very outstanding and that made the colour on the final work looked appealing and interesting despite the bleeding. The colours were more distinct from each other and more defined at the edges.

- **Poster Colour:** The poster colour dried very fast on the linen sheet upon application as the colour bled through the reverse side of the sheet. All the same the final work appeared well. The paper felt harder than before the painting was done.

Pictures of Tested Drawing and Painting Mediums on Combined Linen and Mulberry Papers



Plate 4.8: Colour pencil work



Plate 4.9: Watercolour work



Plate 4.10: Pastel work



Plate 4.11: Oil and acrylic paint work



Plate 4.12: Poster colour work

Reaction of Cotton and Mulberry Papers to Drawing and Painting Mediums – See Plates 4.13 – 4.18 for pictures of the sample products.

- Colour Pencils: Colour pencils worked excellently on the cotton sheets. There was no removal of fibre content from the surface of the sheet even when the pencils were scratched hard on the surface of the sheet; the finished work also appeared good. The colours were outstanding and had a glossy appearance.
- Watercolour: When watercolour was applied on the cotton it dried slowly. It made the colours run into each other to create accidental effects on the sheet. There was a feeling of freshness shown with the watercolour in the finished work. The transparent quality of watercolour was also seen in the work. There was no bleeding of the colours.
- Pastel: The pastel sticks created excellent effects on the roughly textured side of the cotton sheet. The fibres on the surface of the paper did not peel off during the application of the pastel on it. The sheet accepted the pastel very well and allowed the individual colours to stand out as vivid as possible. The finished work appeared like real objects that could be picked from the sheet.
- Oil Paint: The cotton sheet reacted well with the oil paint: the structure of the work was well defined without any bleeding of the paint. However, there was a slight seeping of the oil solvent through the paper to the back. There was no fading of the colours after the work dried.

- Acrylic: The acrylic paint worked well on the cotton sheet: the structure of the work came out well with a slight bleeding of the paint through the back of the sheet. The edges of the work were well defined and the acrylic demonstrated no fading. The colours were solid on the paper.
- Poster Colour: The colours in the work were distinct from each other with a well defined work. The poster colour did not show any bleeding and fading effects on the paper. See Plates 4.13 – 4 .18 for pictures of work.

Pictures of Tested Drawing and Painting Mediums on Combined Cotton and Mulberry papers



Plate 4.13: Colour pencil work



Plate 4.14: Watercolour work



Plate 4.15: Pastel work



Plate 4.16: Oil paint work



Plate 4.17: Acrylic paint work



Plate 4.18: Poster colour work

Reaction of Nylon and Mulberry Papers to Drawing and Painting Mediums – See Plates 4.19 – 4.23 for sample art works

- **Colour Pencils:** The movement of the colour pencils on the nylon sheet made the fibre content peel off. This effect made it uncomfortable working with the colour pencils on the sheet.
- **Watercolour:** Although fibres of the nylon paper peeled off very easily, gentle brush strokes with watercolour exhibited very good effects. Looking at the work critically, there were small spaces within the painted area which did not take the watercolour paint: these accidental effects made the work unique. The bleeding of the paint on and through the sheet did not make the work to be well defined. The sheet also absorbed the paint very fast when it was applied.
- **Pastel:** The pastel sticks made the fibre content of the nylon sheet to flake. Pastel control was quite difficult as any little pressure applied on the pastel removed the fibres from the surface of the fabric.
- **Oil and Acrylic Paint:** The combination of the two colours on the nylon sheet appeared very strongly in a well-defined composition but with a slight bleeding at the reverse side of the sheet.

- Poster Colour: The gentle application of the poster colour on the nylon sheet produced a well defined work which did not bleed.

Pictures of Tested Drawing and Painting Mediums on Combined Nylon and Mulberry Papers



Plate 4.19: Colour pencil work



Plate 4.20: Watercolour work



Plate 4.21: Pastel work



Plate 4.22: Oil and Acrylic paint work



Plate 4.23: Poster colour work

Reaction of Polyester and Mulberry Papers to Drawing and Painting Mediums – Plate 4.24
– 4.28 show sample art works

- Colour Pencils: Just like the nylon sheet, the fibre content of the polyester sheet also flaked off when the colour pencils were applied on it.
- Watercolour: The watercolour paint applied on the polyester sheet dried quickly as it bled to the back of the sheet. This made paint control difficult but the final work looked well defined with bright colours.
- Pastel: The pastel sticks made the fibre content of the polyester sheet to flake off. This made it difficult to control their application.
- Oil and Acrylic Paint: The oil and acrylic paint bled through the polyester sheet, but created a well defined painting on the sheet. The sheet felt flabby after the painting.
- Poster Colour: The combined polyester and mulberry sheet received the poster paint well without any problem; however the dried poster colour felt very hard on the polyester sheet.

Pictures of Tested Drawing and Painting Mediums on Combined Polyester and Mulberry Papers



Plate 4.24: Colour pencil work



Plate 4.25: Watercolour work



Plate 4.26: Pastel work

Plate 4.27: Oil and acrylic paint work

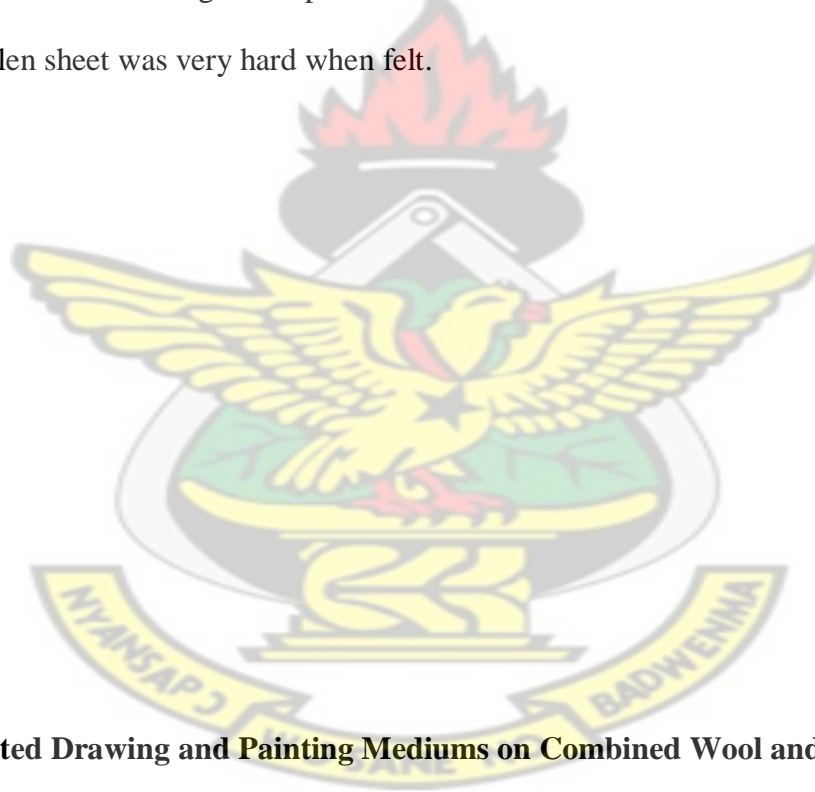


Plate 4.28: Poster colour work

Reaction of Wool and Mulberry Papers to Drawing and Painting Mediums – See Plates 4.29 – 4.33 for sample of works

- Colour Pencils: The use of colour pencils on the surface of the woollen sheet made the fibre content of the sheet peel off.
- Watercolour: There was no fluidity in the watercolour work on the woollen sheet and the transparency effect of watercolour was completely lost in the work. The colours also looked dull on the paper due to the colour of the wool.

- Pastel: The application of pastel strokes on the woollen sheet made the fibre content of the woollen sheet peel off. This made it uncomfortable to work with the pastel sticks on the sheet.
- Oil and Acrylic Paint: The application of the oil and acrylic paint on the woollen paper worked well to bring out the features of the work. The media was well supported by the paper.
- Poster Colour: The poster paint dried very fast after its application on the woollen sheet but there was no bleeding of the paint on the reverse side of the sheet. The poster paint on the woollen sheet was very hard when felt.



Pictures of Tested Drawing and Painting Mediums on Combined Wool and Mulberry Papers



Plate 4.29: Colour pencil work



Plate 4.30: Watercolour work



Plate 4.31: Pastel work

Plate 4.32: Oil and acrylic paint work



Plate 4.33: Poster colour work

Reaction of Acetate and Mulberry Papers to Drawing and Painting Mediums – See Plates 4.34 – 4.39 for pictures of works

- Colour Pencils: The application of colour pencils on the acetate sheet made the surface fibres to flake off. The colour therefore did not appear well on the surface of the paper.
- Watercolour: The watercolour paint on the acetate sheet showed similar qualities as that of the watercolour on the nylon sheet. The sheet absorbed the paint quickly when it was

applied. The paint's inability to take certain portions within the work also created excellent accidental effects.

- Pastel: The pastel strokes made the acetate sheet flake off. It was therefore difficult to control the pastel on the paper. Due to this, the pastel appeared faint and invisible on the paper.
- Oil Paint: In applying the oil paint on the acetate sheet, the fibre content of the acetate sheet clogged to the ferrule part of the painting brush which made the painting difficult. Although there were loose fibres on the surface of the paper, the paper supported the oil paint well; this was evident from the work.
- Acrylic Paint: The application of the acrylic paint was done without any fibre removal from the acetate sheet and the finished work looked fine and smooth. The paint was bright and vivid on the paper. The colours were distinct as well and there was no evidence of fading of the work.
- Poster Colour: Poster colour application on the acetate sheet was successful without any problem. The dried poster paint on the sheet was hard when felt. The poster was well supported by the paper. The colours looked natural and fresh on the paper. There was no evidence of pale or fading effect on the work.

Pictures of Tested Drawing and Painting Mediums on Combined Acetate and Mulberry Papers



Plate 4.34: Colour pencil work



Plate 4.35: Watercolour work



Plate 4.36: Pastel work



Plate 4.37: Oil paint work



Plate 4.38: Acrylic paint work

Plate 4.39: Poster colour work

Reaction of Linen, Cotton and Mulberry Papers to Drawing and painting Mediums –See Plates 4.40 – 4.44 for art works

- Colour Pencils: Working with colour pencils on the mixture of linen, cotton and mulberry sheet was excellent. The strong and hard nature of the sheet made the pencil strokes to appear well.
- Watercolour: The application of watercolour on the sheet dried very fast, with the colour bleeding through to the reverse side of the sheet. The finished work looked defined but had a pale appearance. The paper looked a little wrinkled after the paint had dried.
- Pastel: The pastel also worked excellently on the sheet, with the final work appearing very well. The fibres on the surface of the paper did not peel off during the application of

the pastel on it. The sheet accepted the pastel very well and allowed the individual colours to stand out.

- Oil and Acrylic Paint: These paints worked well on the sheet, with the finished work appearing bright and fresh. The media did not bleed through the paper but the oil solvent bled through at the points of high concentration.
- Poster Colour: The poster colour application on the mixture of linen, cotton and mulberry sheet was successful and excellent. The paper felt harder than it was before it was used for the painting. The colours were distinct from each other and the work had well defined edges. The poster colour also did not show any fading effect on the paper.

Pictures of Tested Drawing and Painting Mediums on the Mixture of Linen, Cotton and Mulberry Papers

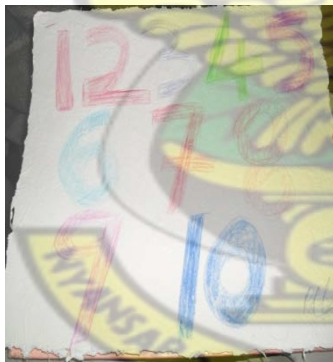


Plate 4.40: Colour pencil work



Plate 4.41: Watercolour work



Plate 4.42: Pastel work

Plate 4.43: Oil and acrylic paint work



Plate 4.44: Poster colour work

It is evident here that Colour pencils did not work well on linen, nylon, polyester, wool and acetate sheets, because the fibres of the sheets did not bond together strongly. With the nature of application of the coloured pencils, the loose fibres of the sheets could not stand the pressure. Cotton and the mixture of linen, cotton and paper mulberry worked excellently with the colour pencils because of the strong bonding nature of the fibres of the sheets.

The bleeding and fast drying of the watercolour that was recorded on linen, nylon, polyester, wool, and acetate was due to the porous nature of the sheets. The mixture of linen, cotton and paper mulberry sheets also recorded bleeding and fast drying although the fibres of the sheet looked compact. This could be that there is a degree of porosity with the sheet due to the linen fibre content. This means that in order to work comfortably with watercolour on linen, nylon, polyester, wool, acetate, and the mixture of linen, cotton and mulberry sheets, the painting must be done quickly and fast. Only cotton combined with the mulberry sheet, recorded no bleeding and slow drying of the watercolour paint. This means that, the compact nature of the fibres of the sheet made the watercolour to dry slowly which resulted in the easy control of the paint on the sheet.

Like the colour pencils, pastel did not work well on linen, nylon, polyester, wool and acetate because of the inability of the fibres of the sheets to bond together strongly. Again, cotton and the mixture of linen, cotton and paper mulberry sheets worked excellently with the pastel sticks because of the firm bondage of the fibres of the sheets. This means that pastel sticks can be suitably used on handmade sheets from cotton waste combined with paper mulberry and the mixture of linen, cotton and paper mulberry sheets.

With regard to the seven sheets with the oil and acrylic paints on them, all of them appeared well although the different sheets exhibited different qualities in reaction to the two paints. This means that all the seven sheets can support oil and acrylic paints well.

From the testing, linen, cotton, nylon, polyester, wool, acetate and the mixture of linen, cotton and paper mulberry sheets all supported the poster paint very effectively although linen recorded some bleeding.

Suitability of Handmade Papers in Book Form

1. Linen and Mulberry Papers

The sheets were comfortably sewn into a book but the mushy nature of the linen sheets made writing on them feel foamy. This nature of the paper caused the writing to look blurred and faint. Because of the soft nature of the sheets, the paper made no flipping sound when the pages were flipped. See Plate 4.45 for finished sample.



Plate 4.45: Book from combined linen waste fabrics and paper mulberry

2. Cotton and Mulberry Papers

With the crispy nature of the thin sheets produced from the cotton fabrics and mulberry, it was very easy sewing a book out of the sheets and writing on the sheets also felt like writing on machine made papers. The writing was very legible on the paper. The book was easy to open because the sheets could be easily flipped. Flipping sounds were made when the sheets were flipped. See Plate 4.46 for sample of book.

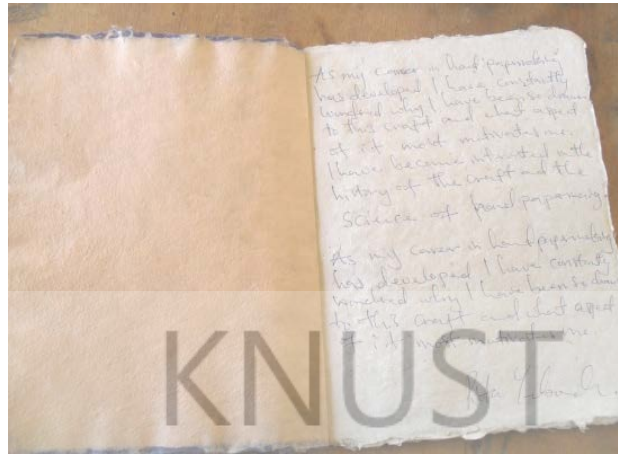


Plate 4.46:
combined cotton waste fabrics and paper mulberry

Book from

3. Nylon and Mulberry Papers

Sewing a miniature book out of the nylon sheets was not comfortable because the fibres peeled off when holes were punched in. In addition, because of the fluffy and soft nature of the sheets, they tore apart when sewing was done. Writing in the book made the fibres flake. The entire book felt soft to the touch and the touch could be compared with a soft carpet. The pages made no flipping sound upon flipping. The writing was not very legible in the book and it appeared faint. The pages also remained in position when flipped. See Plate 4.47 for finished book.



Plate 4.47: Book from combined nylon waste fabrics and paper mulberry

4. Polyester and Mulberry Papers

The polyester sheets were sewn into a miniature book without any problem, but the fibre content of the sheets flaked off when the sheets were written on. The writing was not legible and it appeared faint on the paper. No flipping sound was heard when the sheets were flipped and the sheets did not return to their position when flipped. See Plate 4.48 for sample of book.

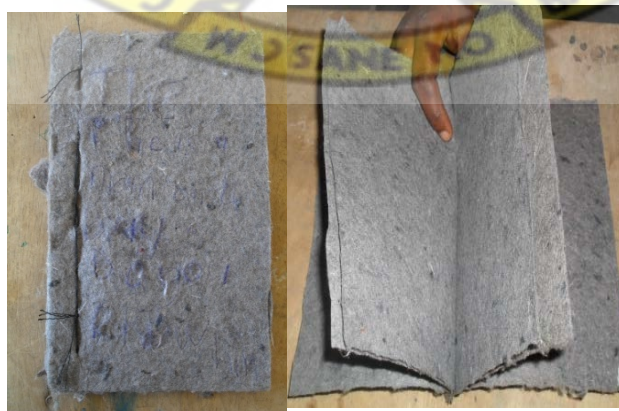


Plate
from combined polyester waste fabrics and
mulberry

4.48: Book
paper

5. Wool and Mulberry Papers

Making a miniature book out of the woollen sheet was not very suitable. The soft and non-crispy nature of the sheet coupled with the loose bonding of the fibres made the sewing thread to tear through the sheets. Writing on the sheets also made the fibre content peel off. The writing was not legible on the sheets it appeared faint and blur. The book was a bit thick when felt and the pages made no flipping sound when flipped. See Plate 4.49 for sample of book.



combined wool waste fabrics and paper mulberry

Plate 4.49: Book from

6. Acetate and Mulberry Papers

The fibre content of the sheets was flaking off as the book was being sewn. Writing on the sheets also made the fibre content peel off. The writing appeared faint, dull and blur on the sheets. The entire book was soft to the touch and it could be likened to a soft carpet. See Plate 4.50 for sample of book.



Plate 4.50: Book from combined acetate waste fabrics and paper mulberry

7. Linen, Cotton and Mulberry Papers

The strong nature of the sheets produced from the mixture of linen, cotton and mulberry fibre made it easy sewing a miniature book out of it. Writing on the sheets was comfortable and suitable. The writing was very legible on the sheets. The flipping sound made by the sheets when they were flipped was low as compared to that of the combined cotton and mulberry sheets. See Plate 4.51 for finished book.

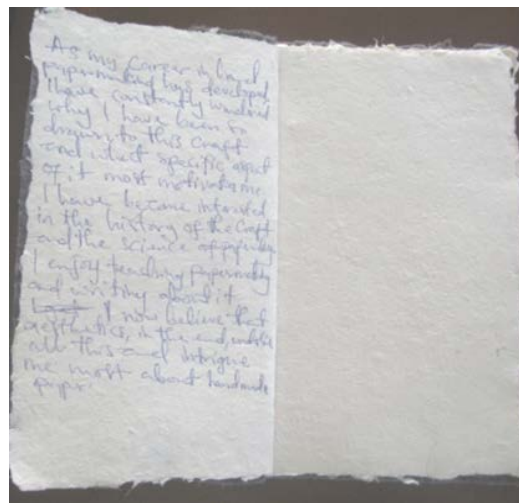


Plate 4.51: Book from combined linen, cotton and paper mulberry

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The tests show that differences exist in the way each type of paper made from the different fabric and mulberry fibre reacted to their use in book form. It was observed that all the sheets that dried with one side smooth and the other rough meant every sheet provided two surface textures to choose from. Considering the suitability of these handmade papers being used as miniature books, the combined cotton waste and paper mulberry and the mixture of linen, cotton and paper mulberry sheets worked excellently because of the strong bondage of the fibres of the sheet. Linen worked partially because, although the sheets could be written on, the foamy nature of the sheets made it very uncomfortable to use. The nylon, polyester, wool and acetate sheets did not work as writing pads because of the fluffy nature of the sheets. It can be concluded that paper derived from the combination of cotton and paper mulberry and the mixture of linen, cotton and paper mulberry can produce useful sheets of papers that can be used as writing pads.

In satisfying Objective Four of the study, which was to organize a workshop for 20 art teachers in Kumasi and introduce them to the process followed and the outcome of Objectives One to Three, the researcher conducted a Group Interview with participants at the workshop to find out their views on Whether Waste Recycling is Necessary.

It was realised from the attitudes and opinions expressed by participants interviewed that recycling waste into useful products is a worthwhile activity that needs to be encouraged at all levels of Ghanaian education. The participants said this will help individuals in the country to be more creative and innovative to know how to handle waste and develop the love for manual work in students. They were very passionate on how waste of different kinds is taking over our environment without anything being done about it. A participant mentioned that “if nothing useful is done about the waste that we generate every day, it will cause problems for the environment and for the individuals who live in the environment” (personal communication, November 27, 2010). This showed that the effects of waste on the environment and our communities were primary concerns of the participants. Another participant also voiced out that

“if individuals in the country continue to be ignorant about proper waste management, a day will come that waste will take over the environment” (personal communication, November 27, 2010). This suggests that the workshop was a positive effort in saving the environment.

The attitudes of the participants however, differed as to the possibility of implementing recycling programmes in Ghanaian schools. Some were of the opinion that it depends on the education and curriculum developers and planners in the country. Others thought that waiting for education and curriculum planners to include recycling in the syllabi before teaching recycling in Ghanaian schools is not feasible. However a participant said “recycling activities and programmes can be treated as extracurricular activities or teachers and students can form clubs where such activities can be handled” (personal communication, November 27, 2010).

A participant even made it known that papermaking is actually in the Junior High School syllabus under visual art but most teachers do not teach it. This revelation brought the argument on whether it is only the artist who needs recycling and why recycling should be captured in the visual art component of the Basic Design and Technology syllabus for Junior High Schools. Participants strongly objected to the idea of recycling being identified with only visual art, saying recycling can be incorporated in science, social studies, mathematics, and all subjects taught in Ghanaian schools as this will be beneficial to students.

When asked if participants had practical recycling programmes already operating in their schools, only one teacher participant made mention of the fact that their school was in a collaborative programme with another school outside Ghana, where the programme focuses on waste recycling. The rest of the teacher participants did not have any practical recycling programmes in their schools. As to why this was the situation the participants could not give any reasons. As to whether participants knew of recycling programmes in other schools aside theirs, it was found that none of the participants knew of any school that operates a practical recycling programme for its students. The implication is that there may be few or no practical recycling programmes organised in schools in Ghana.

With regards to participants who already had ideas on waste recycling and were practising their ideas before participating in the workshop, only one participant shared the fact that he recycles waste papers to produce sculpture works and has been teaching his students the processes involved in doing so.

With regards to the attitudes of Ghanaians to recycling, the interview revealed a variety of answers. A section of the participants shared the view that they do not see recycling as a natural behaviour of the people of Ghana. Instead, Ghanaians always want new and already made products because of laziness and lack of education. They added that this attitude is evident in the low maintenance culture practised in the country, meaning that periodical servicing, repair and care for personal property or state property to prolong their lifespan are very low in the country. Other participants argued that formerly, recycling was not evident among the people of Ghana but now some individuals are becoming more conscious of the recycling attitude. Examples were given on how some individuals are producing useful items such as bags and furniture out of waste plastic bags and bottles.

A prominent example cited by the participants was the KNUST Communication Design student who used plastic bottles to manufacture room furniture which were exhibited at the Trade and Technology fair (TRATECH) that was held in KNUST recently. Participants articulated passionately that educating individual Ghanaians on the need, importance and benefits of recycling can help individuals in the country to appreciate the usefulness of recycling. The interview also required participants at the workshop to share their views and experiences on the workshop. One teacher said “At first, when I heard of papermaking, I thought of the use of machines but now I know that useful papers can also be made manually through a very smooth process with local materials” (personal communication, November 27, 2011). Other participants described the papermaking process as an interesting process which they enjoyed. Throughout the workshop, participants articulated that they had learnt a new activity which they did not know of. Some participants also said that there are no practical recycling programmes in their schools and with what they had witnessed, they intended starting something with their students.

One participant expressed that his school is in a collaborative programme with a school in the United States of America, where the focus and purpose is how to reduce waste through recycling, so this papermaking workshop was a step in the right direction for him. A number of the participants articulated that they had student clubs in their schools so they will introduce the knowledge they had acquired to the students.

There were concerns among the participants about how what they had experienced at the workshop could be extended to other teachers who were not present at the workshop. Some suggested that there is a resource centre in the Kumasi metropolis for teachers, so the authorities in charge of the place should be made aware of the papermaking project so that they can learn it and teach the teachers. The truth is that the man in charge of the resource centre was invited for the workshop but he did not come.

The interview with the workshop participants revealed that introducing the Ghanaian student to practical recycling activities and programmes is an important venture that must be encouraged. The participants also said recycling activities are not beneficial to only visual art and technical students but all students can benefit from them irrespective of the subject they are studying. Hence, such activities must not be relegated to only visual art and technical students. It is evident from the views of the participants that it is through education on waste recycling that the need for recycling can be instilled into the individuals in the country. The Junior high school art teachers who are not teaching their students papermaking are likely to lack expertise in and therefore need to be taught. Experiences shared by participants at the workshop show that through the workshop, participants had learnt a new and a useful thing. This is because they saw the project done as a very useful and important venture. For recycling and reusing of waste to become part of individuals in the country Ghanaians need education. The education could begin from the schools as this project shows.

To achieve Objective Five which was to follow up on the teachers who attended the workshop to find out what they did with the skills they acquired at the workshop, the researcher was able to visit four schools where four participants were able to introduce what they learnt and

experienced at the workshop to their students. Three of them were Junior High school teachers while one was a primary school teacher.

At the Weweso Junior High School, the teacher participant had taught the students how to combine waste paper and paper mulberry in hand papermaking to produce useful sheets. According to the teacher participant, the students responded positively to the exercise and were very excited about the whole process. Every student present showed an interest in the exercise and wanted to partake in the process. The students were very amazed about how loose fibres in water were able to form sheets of papers. In general, the teacher participant described the class as lively and very interesting (personal communication, February 17, 2011). See Plates 4.52 – 4.54 for pictures of this exercise.

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Pictures of Weweso Junior High School Students Working

**Plate
of Weweso scooping
mould**



**4.52: A student
pulp onto a**



Plate 4.53: Students of Weweso squeezing water from a wet sheet with foam



**Students of
working on
handmade**

**Plate 4.54:
Weweso
their
sheets**

At the Boadi

Primary

School, the teacher participant had taught her students how to use waste polyester and linen fabrics with paper mulberry to make handmade papers. Information obtained from the teacher participant indicated that some of the students told her that the process was interesting and fun and it was their first time of learning to make their own papers. Some said that they had seen how to make papers manually and so they would try the process at home. Others also said they had learnt how to use waste fabrics to make papers so when they see dressmakers going to throw away their waste, they would collect them and try their hands on what they had learnt. Others also said they were happy to know how to make their own papers and that they liked the process.

The head of the school and teachers from other classes were also amazed about how waste fabrics could be used to make sheets and said, it was their first time of witnessing such a process. According to the teacher participant the students who took part in the exercise had fun and every students present was keen to have a feel of the sheet forming process. Overall it was a worthwhile exercise for the students (personal communication, February 24, 2011). See Plates 4.55 – 4.59 for pictures of this exercise.

Boadi Primary School Students Working

Plate 4.55: A Boadi pupil shaking pulp
pupils ready to scoop
moulds



Primary school
with two other
pulp onto their

Plate 4.56: A Boadi
pupil holding a
wet sheet with
pupil ready to make his



Primary
mould with
another



sheet

Plate 4.57: A pupil of Boadi Primary school squeezing water from a wet sheet with foam



**Pupils of Boadi
working on their**

**Plate 4.58:
Primary
sheets**



**Plate
Display of works
handmade sheets
Primary pupils**

**4.59:
on
by Boadi**

At the Bomso Junior High School, the students had been introduced to hand papermaking using acetate and cotton waste fabrics with paper mulberry. The students were taught the theory of hand papermaking before they were introduced to the practical. According to the teacher

participant, the students present were eager to take their turn in making the sheets and every student made sure his or her sheet came out well. Students who took their turn first in making their sheets helped their fellow students who were yet to make their sheets. The teacher participant also said that some students confessed they never knew that paper could be made easily. In all, the participation of the students was very encouraging. Teachers in the school also took turns to pass by to witness the exercise (personal communication, February 28, 2011). See Plates 4.60 – 4.63 for this exercise.

**Pictures of
School**

**Bomso Junior High
Students Working**

**Plate 4.60:
cutting raw
pulping**



**Bomso students
materials for**



**Plate

students
High
their**



**4.61: Teacher
participants
coaching
of Bomso Junior
school to form
sheets**

Plate 4.62: Student of Bomso coaching her mates to squeeze water from wet sheets



Plate 4.63: Teacher students of Bomso seeing to dry sheets

participant and Junior High School

At the KNUST Junior High School the participant exposed the rest of the teachers in his department to what he was introduced to at the workshop. From there, Form Two students in the school were taught how to recycle waste cotton and linen fabrics with paper mulberry into useful handmade papers. The teacher participant commented that the students actively participated in the process and every student present made sure he or she made a paper of his or her own. The students were very excited about the whole process and some took home already prepared pulps, with the intention of trying their hands on the papermaking process at home. In general, the papermaking process was a good exercise the students encountered. (personal communication, March 08, 2011). See Plates 4.64 – 4.67 for this exercise.

KNUST Junior High School Students Working

coaching student to



Plate 4.64: Teacher make sheet

Plate 4.65:
water from a wet sheet



**Student draining
on a mould**

Plate 4.66:



Students

squeezing water out of wet sheets with foam

**Plate
appreciating
handmade sheets**



**4.67: Students
their works on their**

Looking at the communication from the four teacher participants who were able to introduce the process of using waste materials combined with paper mulberry in making useful sheets to their students, it is clear that the students who took part in the four exercises described earlier did so with enthusiasm, they had fun and in addition they learnt the important lesson of reusing waste to make another useful item. The attitudes that were exhibited by these students in the four schools who had the opportunity to go through the papermaking experience using waste materials give an indication that if the recycling concept is encouraged in Ghanaian schools it would be embraced positively by students and they would learn lots of interesting ideas from it. The fact that some students, after making their sheets assumed the responsibility of helping their fellow students to also make their sheets as peer tutors can enhance and shape their leadership qualities. If recycling activities are encouraged in Ghanaian schools with students overseeing them, not only will they benefit from the programme in terms of knowledge but also would acquire or improve their leadership skills. Again, participants from all four schools expressed that students saw the process of papermaking a fun activity which they enjoyed to the fullest. This was a very good experience that students comprehended through a learning process. This means that if students are introduced to such recycling activities, they would be having fun and at the same time learn important things. Although only four participants were able to introduce what they had experienced at the workshop to their students in time to give feedback to the researcher, the evidence indicates that

the workshop organised by the researcher as part of this study was worthwhile because the feedbacks from the four participants were very positive. Their students had learnt and enjoyed the process of making papers from waste materials and made wonderful works with their sheets. It is possible that the other teacher participants may also introduce what they experienced at the workshop to their students later on.

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CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

The chapter outlines the summary of the study, research findings, conclusions drawn from the findings and recommendations.

5.1 Summary

The research found that waste fabrics can be combined with paper mulberry to make useful sheets of papers on which different drawing and painting mediums could be used and could also be used to make books. An important aspect of the project was the workshop that was organised to introduce selected art teachers to the process of hand papermaking so that they could in turn teach their students and thereby let them appreciate the usefulness of waste recycling.

The project indicates that: linen, cotton, nylon, polyester, wool and acetate waste fabrics combined with the inner bark of the paper mulberry plant are suitable for papermaking. Experiments conducted with the six fabrics in hand papermaking using fabric types plus paper mulberry fibre proved that all six fabric types had potential for producing good and useful sheets for art making and writing. Dried sheets produced out of all six fabrics made it possible to draw and paint on them with colour pencils, pastels, watercolour, poster colour, oil and acrylic paints. In addition, miniature books were produced from all the six types of sheets.

Considering the drawing and painting mediums that were tested on the handmade sheets, colour pencils were not suitable to work with on linen, nylon, polyester, wool and acetate sheets.

Colour pencils were very suitable to work with on cotton and a mixture of linen, cotton and paper mulberry sheets. Water colour worked well and suitably on cotton sheets. Linen, nylon, polyester, wool, acetate, and a mixture of linen, cotton and paper mulberry sheets recorded bleeding and fast drying of the watercolour paint upon application on the sheets which made paint control difficult. Pastel sticks were not suitable to work with on linen, nylon, polyester, wool and acetate sheets. But pastel worked suitably and very well on cotton and a mixture of linen, cotton and paper mulberry sheets. Oil and acrylic paints worked suitably on linen, cotton, nylon, polyester, wool, acetate and a mixture of linen, cotton and paper mulberry sheets although there were some bleeding effects. Poster colour worked well on linen, cotton, nylon, polyester, wool, acetate and a mixture of linen, cotton and paper mulberry sheets with some of the sheets bleeding, but the finished works came out well.

Most of the sheets bled from the painting mediums. Smith (1995) and Hiebert (1998) make mention that, to prevent such occurrences papermaking pulps must be coated with a sizing substance like liquid laundry starch. In this project pulps were not coated with any sizing substance and so, it can be said that without sizing substances, handmade papers are likely to bleed when painting mediums are applied on them.

From the produced papers, it was discovered that cotton waste combined with paper mulberry sheets, and a mixture of linen, cotton and paper mulberry sheets made excellent miniature writing pads. Linen and paper mulberry miniature pad was uncomfortable to write on. Nylon, polyester, wool and acetate sheets did not work well as writing pads.

5.2 Conclusions

This confirms the author's view that for waste recycling to become part of Ghanaians it will take education; this type of education can start from our schools. Teachers and all in charge of education in the country have a role to play in educating and instilling the recycling attitude in the Ghanaian. It can be deduced from the group interview organised at the workshop that education can help make the individual Ghanaian to become aware of the need for waste recycling. Also it was discovered that papermaking is in the Junior High School syllabus as part of Basic Design and Technology (BDT) but most schools ignore it. The workshop has revealed that this might be due to lack of expertise on the part of the teachers who are in charge of the subject in the schools. It is now possible for teachers who took part in the workshop organised by the researcher and students who have experienced hand papermaking in their schools to embrace the recycling exercise positively to make learning fun while also gaining new skills and knowledge at the same time.

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5.3 Recommendations

The following recommendations can be implemented:

1. The government of Ghana must establish a pulp and paper mill in Kumasi where waste fabrics and paper mulberry which is in abundance in the country can be used for manufacturing papers for local use as well as for export.
2. The Ghana Education Service must organise workshops for creative art teachers to teach them the hand papermaking process since it is in their syllabus. This project can serve as a basis for such workshops so that the Junior High School teachers can teach the subject effectively across the country.
3. Schools in Ghana must set up practical recycling programmes and activities in their schools, to help instil the need and the importance of recycling in students.
4. To sustain recycling programmes and activities in schools, heads of schools must be willing to provide basic equipment and tools that students need to work with.

5. The Department of General Art Studies where the researcher is a student must organise workshops on hand papermaking using local materials for interested individuals and also generate publications to disseminate the information.
6. Further research must be carried out to identify recyclable waste materials that can adapt themselves to recycling.

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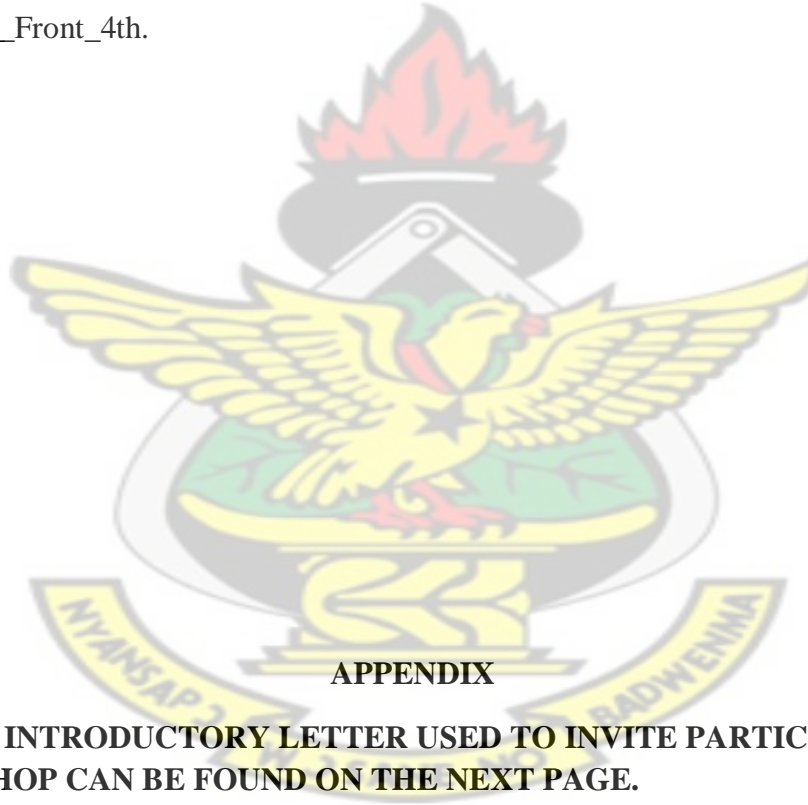
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APPENDIX

APPENDIX A: INTRODUCTORY LETTER USED TO INVITE PARTICIPANTS TO THE WORKSHOP CAN BE FOUND ON THE NEXT PAGE.

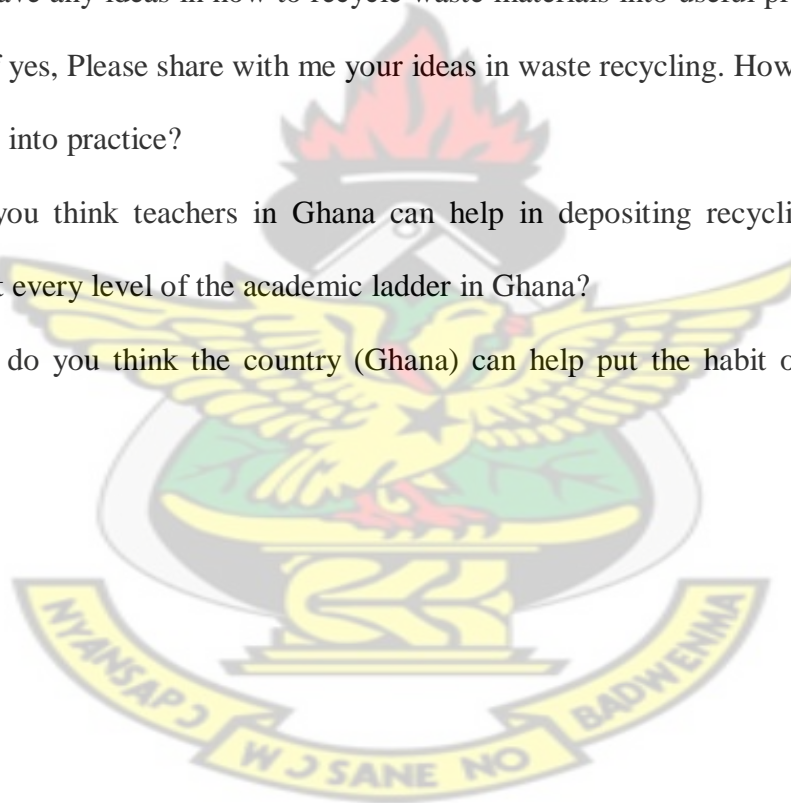
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APPENDIX B: INTERVIEW GUIDE USED FOR THE GROUP INTERVIEW AT THE WORKSHOP.

Questions for Group Interview

1. What do you think will happen to the environment if we don't recycle?
2. Do you think it is necessary to introduce recycling programmes at every level in Ghanaian schools?
 - Why is it necessary or why is it not necessary?
3. What will students gain from recycling programmes in Ghanaian schools?
4. Is it possible to implement recycling programmes at all levels in Ghanaian schools?
5. In a few words describe your experiences with the process involved in this papermaking project.
6. In a few lines describe what you intend to do with the information and knowledge you have acquired through this project.
7. Is there any practical recycling programme in your school? If yes, please explain what it entails and how it operates? If no why do you think there is no such a programme in your school?
8. Are there any other recycling programmes in other schools that you know off?

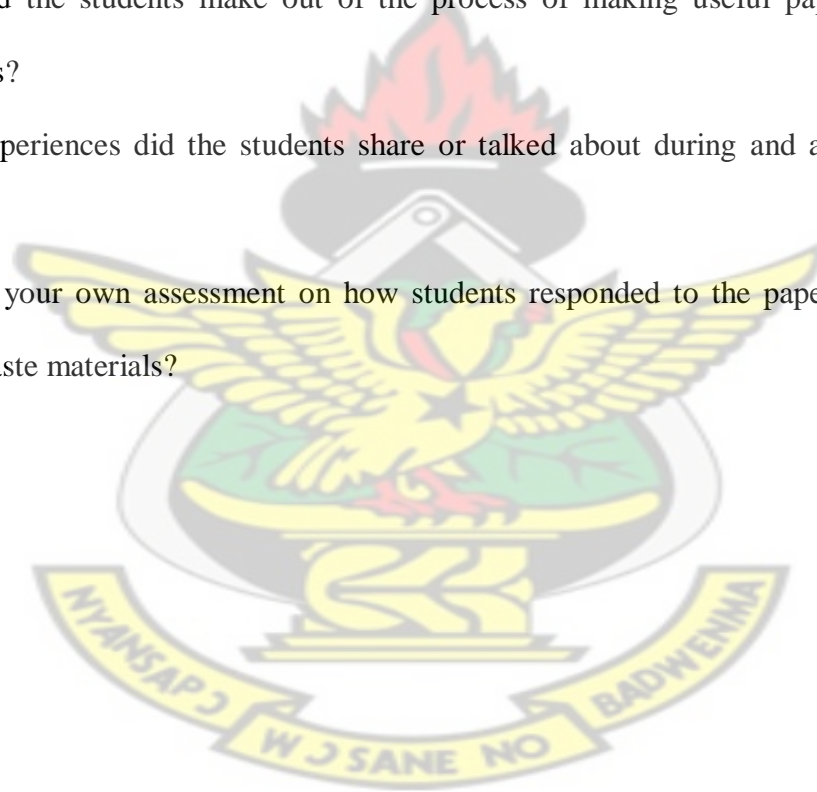
9. How do you see the products that have been derived from the waste fabrics which under normal circumstance would have ended up in landfills?
10. What are your views on how waste is handled in Ghana? Are there any problems or challenges the country faces in taken care of its waste? How do you think waste in Ghana should be treated or handled?
11. Do you see recycling a part of life and nature of the people of Ghana? If yes how, give examples? If no why do you think the situation is so?
12. Did you have any ideas in how to recycle waste materials into useful products before this project? If yes, Please share with me your ideas in waste recycling. How have you putting your ideas into practice?
13. How do you think teachers in Ghana can help in depositing recycling behaviours in students at every level of the academic ladder in Ghana?
14. How best do you think the country (Ghana) can help put the habit of recycling in its people?



APPENDIX C: INTERVIEW GUIDE USED FOR IN-PERSON INTERVIEW TO OBTAIN FEEDBACK FROM PARTICIPANTS.

Questions used for In-Person Interview

1. What was the working atmosphere like?
2. What was the level of participation of the students?
3. What did the students make out of the process of making useful papers using waste materials?
4. What experiences did the students share or talked about during and after the working process?
5. What is your own assessment on how students responded to the papermaking process using waste materials?



APPENDIX D: SAMPLES OF HANDMADE PAPERS

Linen and paper mulberry

Cotton and paper mulberry

Nylon and paper mulberry

Polyester and paper mulberry

SAMPLES OF HANDMADE PAPERS - CONTINUE

Wool and paper mulberry

Acetate and paper mulberry



The combination of linen, cotton and paper mulberry

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