Arts and Design Studies
ISSN 2224-6061 (Paper) ISSN 2225-059X (Online)
Vol.59, 2017

Innovation in Weaving Napkin on the Kente Loom

*Gbadegbe Richard Selase[1] Vigbedor Divine[1] Agra Florence Emefa[2] Amankwa Joana[2]
Gbetodeme Selorm [2]
1.Department of Industrial Art, Ho Technical University, P. O. Box, 217, Ho, Volta Region, Ghana
2.Department of Fashion Design and Textiles, Ho Technical University, P.O. Box, 217 Ho, Volta Region, Ghana

Abstract
The Kente weaving industry in Ghana is a vibrant one. It is one of the foreign exchange earners of the country. Although meagre, the revenue generated by the Kente weaving industry in Ghana makes a significant impact on the citizenry. Apart from the economic value of Kente, the fabric plays a great role in the socio-cultural development of Ghana. Kente is worn during festive occasions such as durbars, outdooring of chiefs and newly born babies as well as marriage ceremonies. Kente is worn all-over the world to portray the Ghanaian culture. However, current developments where Kente fabrics are being pirated by the Chinese and other Nationals give a cause for concern. There is the need to move away from the usual blame games towards finding a lasting solution to this canker. One of the ways of addressing this issue is to pay much attention to quality and rebranding of the Kente weaving industry. It is for this and many other reasons that this topic which is aimed at modifying the Kente loom to weave napkin and other fabrics came to mind. Considering the technical nature of the topic, the descriptive (qualitative) method of research was adopted for the study. This made it possible for the adoption of a more practical approach towards realizing the aims and objectives of the study. The main research instruments employed for the study were observation and questionnaires. The accessible population for the study was made up of 90 (ninety) respondents knowledgeable in the field of Textiles. This was categorized into Textile Practitioners, Textile Lecturers and Tutors on one hand and Fashion and Textiles Students on the other hand. A major finding of the study is that, any type of fabric can be woven on the Kente loom provided the necessary changes are made on the loom. It is therefore recommended that the Kente loom should be modernized and if possible mechanized so as to ensure efficiency and quality as well as higher production rate and revenue.
Keywords: Weaving, Quality, Kente loom, Textiles and Foreign Exchange.

1.0 INTRODUCTION

Weaving is acknowledged as one of the oldest surviving crafts in the world. The tradition of weaving traces back to Neolithic times (approximately 12,000 years ago). Even before the actual process of weaving was discovered, the basic principle of weaving was applied to interlace branches and twigs to create fences, shelters and baskets for protection. Weaving is one of the primary methods of textile production and it involves the interlacing of a set of vertical threads with a set of horizontal threads. The set of vertical threads are known as warp and the set of horizontal threads are known as weft.

Textiles in the form of weaving became known to mankind since the biblical era. After man had eaten from the forbidden fruits in the Garden of Eden, he realized that he was naked so he naturally used leaves to cover his nakedness. Later, the leaves were discarded for animal furs and skins which were obtained from the animals he hunted. With the aging of time and the advancement in technology, more complex machines such as power looms, circular knitting machines, rapier and water jet looms were introduced which helped a great deal in the manufacture of fabrics. These new ways of fabric production guaranteed protection and the comfort of the wearer. (Gbadegbe *etal,* 2014)

Weaving can be done by hand or by using machines. Machines used for weaving are called looms. Loom originated from a crude wooden frame and was gradually transformed into the modern sophisticated electronic weaving machine. Nowadays, weaving has become a mechanized process, though hand weaving is still in practice. Basically, there are two major types of looms. These are handlooms and power looms. The handlooms are operated by the foot or by the hand while power looms run on electric power. Examples of handlooms are table loom, broad loom and the traditional loom (Kente loom). The power looms include: rapier, water jet loom, air jet loom, tappet loom, dobby loom and jacquard loom. Although these looms are powered differently, they have virtually the same parts as the handloom.

The principal parts of a loom are the frame, the warp-beam or weavers beam, the cloth-roller (apron bar), the heddles, and their mounting and the reed. The warp-beam is a wooden or metal cylinder on the back of the loom on which the warp is delivered. The threads of the warp extend in parallel order from the warp-beam to the front of the loom where they are attached to the cloth-roller. Each thread or group of threads of the warp passes through an opening (eye) in a heddle. The warp threads are separated by the heddles into two or more groups, each controlled and automatically drawn up and down by the motion of the heddles. In the case of small patterns on the power loom, the movement of the heddles is controlled by "cams" which move up the heddles by means of a frame called a harness. In larger patterns, the heddles are controlled by a dobby mechanism, where the

healds are raised according to pegs inserted into a revolving drum.

Apart from the parts of the looms being the same, the basic operations are also the same. The weaving operations involve the up and down movement of the heddle frames which results in the formation of a v-shaped opening (shed) in the warp, through which the pick is inserted by the help of a shuttle. Individual warp yarns are inserted into the dents of the reed (a comb-like device) and then tied to the apron bar on the cloth roller. The reed determines the width and to a large extent the texture of the woven fabric. If a small size reed is used on a loom, the width of the woven fabric will also be small but if a large size reed is used, the width of the resultant fabric will be wide. In the same vein, reeds with low density (number of ends per inch) produce light weight fabrics while reeds with high density produce heavy weight fabrics.

In Ghana, the most popular type of handloom used by the cottage weavers is the traditional loom. The traditional loom which is popularly called "Kente loom" is used for the production of the famous "Kente" fabric. Kente is a popular Ghanaian woven fabric which is acclaimed the world over. It is a very beautiful and colourful fabric. The Kente loom which produces the Kente fabric makes use of a narrow reed and two pairs of heddle shafts (6-7 inches). This limits the loom to the production of small size fabrics known as strips. The Kente strips which are normally 5 inches wide are sewn together to produce a wider cloth.

In order to weave a wider width of fabric and to save money that will be spent on sewing Kente strips together, the researchers decided to embark on this study to find out ways and means to improve upon the Kente loom and if possible weave napkin as an evidence for a successful research.

2.0 REVIEW OF RELATED LITERATURE

2.1 Overview

For a study such as this, it is necessary to review literature from various sources to fully establish the theoretical framework and lay a strong foundation for an empirical study into the research topic. For these reasons, various books of celebrated authors related to the research topic will be reviewed under this section of the study. Furthermore, the section is sub-divided into the following topics: definition of weaving, history of weaving, types of weaves, types of looms and weaving processes.

2.2 Definition of Weaving

Weaving is a form of art that has been popular throughout time. Many cultures used woven tapestries to document their history, and many people still today weave as a passion. Weaving is easy to do and it does not require costly items. The art of weaving is actually the technique in which you place together two threads to form a fabric. Each of the two threads has its own technical name; one is called weft and the other called the warp. The lowering and raising of the warp thread in a diverse sequence will result in variant weaves. (Innovateus, 2017)

Weaving is a method of textile production in which two distinct sets of yarns or threads are interlaced at right angles to form a fabric or cloth. Other methods are knitting, crocheting, felting, and braiding or plaiting. The longitudinal threads are called the warp and the lateral threads are the weft or filling. (*Weft* or *woof* is an old English word meaning "that which is woven". The method in which these threads are inter-woven affects the characteristics of the cloth. Cloth is usually woven on a loom, a device that holds the warp threads in place while filling threads are woven through them. A fabric band which meets this definition of cloth (warp threads with a weft thread winding between) can also be made using other methods, including tablet weaving, back-strap, or other techniques without looms. The way the warp and filling threads interlace with each other is called the weave. (Wikipedia)

According to the Textiles Centre of Excellence (2017), weaving is a technique of fabric production. It consists of intertwining of two separate yarns or threads at right angles to form a fabric or cloth. Those two threads are called warp and the weft. Fabric is usually woven on a loom which is a device that holds the warp threads in place while weft is woven through them. There are also other methods of weaving. The method where the warp and weft interlace with each other is called the weave. The basic types of weave are plain weave, satin weave and twill which give different patterns and textures of fabrics for different uses.

The process of producing a fabric by interlacing warp and weft threads is known as weaving. The machine used for weaving is known as weaving machine or loom. Different fabrics are produced in the weaving Industry. These fabrics are woven by using various looms and related machines. (Textile Learner)

2.3 History of Weaving

There are some indications that weaving was already known in the Paleolithic era, as early as 27,000 years ago. An indistinct textile impression has been found at the Dolní Věstonice site. According to the find, the weavers of Upper Palaeolithic were manufacturing a variety of cordage types, produced plaited basketry and sophisticated twined and plain woven cloth. The artifacts include imprints in clay and burned remnants of cloth. The oldest known textiles found in the Americas are remnants of six finely woven textiles and cordage found in Guitarrero

Cave, Peru. The weavings, made from plant fibres, are dated between 10100 and 9080 BCE.

The earliest known Neolithic textile production in the Old World of Egypt is supported by a 2013 find of a piece of cloth woven from hemp at the Çatalhöyük site believed to be from around 7000 B.C. Further finds came from the advanced civilisation preserved in the pile dwellings in Switzerland. Another existing fragment from the Neolithic was found in Fayum, at a site dated to about 5000 BCE. This fragment is woven at about 12 threads by 9 threads per cm in a plain weave. Flax was the predominant fibre in Egypt at this time (3600 BCE) and continued popularity in the Nile Valley, though wool became the primary fibre used in other cultures around 2000 BCE. Weaving was known in all the great civilisations, but no clear line of causality has been established. Early looms required two people to create the shed and one person to pass through the filling. Early looms wove a fixed length of cloth, but later ones allowed warp to be wound out at the fell of the cloth. The weavers were often children or slaves. Weaving became simpler when the warp was sized. (Wikipedia)

Weaving was invented much later than spinning; it originally came from West Asia in around 6000 BC. But the exact date or civilization is harder to pin point, as it is harder for fabrics to survive centuries to get proof of when it started. Archaeologists think that basket making and weaving could have been the first things humans started. Every civilization had some kind of basic looms to weave. In the beginning, people just wove narrow bands with their fingers which evolved later to using looms to make clothes and shelter. (Innovateus, 2017)

According to Rozentals, 20,000 – 30,000 years ago, early man developed the first string by twisting together plant fibres. Preparing thin bundles of plant material and stretching them out while twisting them together to produce a fine string or thread. The ability to produce string and thread was the starting place for the development of weaving, spinning, and sewing. Stone Age Man's early experiments with string and thread led to the first woven textiles. Threads and strings of different sizes were knotted and laced together to make many useful things. Finger weaving, lacing and knotting together of threads by hand is still used today by many weavers. During the Neolithic Era, mankind developed great skill in weaving cloth. Every household produced cloth for their own needs. Weaving cloth remained an activity associated with the family unit for thousands of years. By the 11th century, many of the weaving patterns used today had been invented. Skilled weavers developed highly specialized cloth. During this time, the task of weaving cloth began slowly to move away from the family unit into specialized work places. Cloth weaving became a mechanized industry with the development of steam and water powered looms during the Industrial Revolution (1760 – 1815).

The invention of the fly shuttle removed the need to have a weaver place the weft thread into the warp by hand. **John Kay** of Bury, England, first discovered flying shuffle in 1733 which speeded the process of weaving and the production was almost doubled. A fly shuttle is a long, narrow canoe-shaped instrument, usually made of wood, which holds the bobbin. The Jacquard Machine was developed in the early 1800s. This revolutionary machine used a punch card mechanism to operate the loom and is credited as the basis of modern computer science. A textile woven on a loom with a Jacquard Machine can have very complicated patterns. The technological innovations in cloth production made during the Industrial Revolution dramatically changed the role of the weaver. Large volumes of inexpensive cloth were now readily available. Weaving had been changed to a manufacturing industry. Textile workers were among the founders of the modern labour movements. Today most of our textile needs are supplied by commercially woven cloth. A large and complex cloth making industry uses automated machines to produce our textiles. However, there are artisans making cloth on hand looms, in home studios or small weaving businesses, who keep alive the skills and traditions of the early weavers.

Weaving is the action of producing fabric by interlacing warp and weft yarns at right angles to each other. This action can be produced on a frame, hand loom or automatic loom. The handloom has been around many years and with a significant development in 1733 when John Kay developed and patented the 'Flying Shuttle'. This development helped fuel the industrial revolution. The first automatic loom was designed in 1784 by Edmund Cartwright and the next 47 years were spent perfecting this design until Kenworthy and Bullough developed the Lancashire loom in 1842. However this loom was not fully automatic and had to be stopped every time the shuttle needed new weft yarn. In 1984 George Draper and Son's marketed the Northrop loom, a fully automatic loom, with a self feeding shuttle. It was named Northrop loom after its inventor 'James Henry Northrop'. From 1942 technology advanced again with the invention of modern automatic and shuttle less looms. Today weaving is used in far more applications than any other textile manufacturing methods. (Textile Innovation Platform)

Weaving is a technique of fabric production. It consists of intertwining of two separate yarns or threads at right angles to form a fabric or cloth. Those two threads are called warp and the weft. Fabric is usually woven on a loom which is a device that holds the warp threads in place while weft is woven through them. There are also other methods of weaving. The method where the warp and weft interlace with each other is called the weave. The basic types of weave are plain weave, satin weave and twill which give different patterns and textures of fabrics for different uses.

Humans knew about weaving since Paleolithic era. Flax weavings are found in Fayum, Egypt, dating from around 5000 BC. The first popular fibre in ancient Egypt was flax, which was replaced by wool around 2000 BC.

By the beginning of counting the time, weaving was known in all the great civilizations. Early looms needed one or two persons to work on them. Bible refers to loom and weaving in many places.

By 700 AD, horizontal and vertical looms could be found in Asia, Africa and Europe. At that time also appeared pit-treadle loom with pedals for operating heddles. That kind of loom first appeared in Syria, Iran and Islamic parts of East Africa. Faithfuls were required by Islam to be covered from neck to ankle which increased the demand for cloth. In Africa, the rich wore cotton clothing while the poor had to wear wool. By 1177, loom was improved in Moorish Spain which rose higher above the ground on a stronger frame. Now, the weaver's hands were free to pass the shuttle, while operating the heddles was done by the feet. This type of loom became the standard European loom. In Medieval Europe, weaving was done at home and sold at fairs. The craft spread and the guilds were established. Wars, famine and plague shifted manufacturing of fabrics from home to purpose-built centralized buildings.

Colonial America relied on Great Britain for manufactured goods so they began to weave cloth from locally produced fibres. Cotton and wool were mostly used but because of the labour-intensive process to separate the seeds from the cotton fibre, wool was used more. That changed with the invention of the cotton gin, a machine that quickly and easily separates cotton fibres from their seeds. Flax and hemp were also used as a material for fabrics. Plain weave was preferred at the time with decorations woven into the fabric or wood block printing.

Industrial revolution switched weaving from hand to machine. John Kay invented the flying shuttle in 1733 and enabled weaving of wider fabric as well as made it faster. The first factories for weaving were built in 1785. Jacquard loom was invented in about 1803. It could be programmed with punch cards which enabled faster weaving of more complicated patterns. White fabrics were printed mechanically with natural dyes at first with synthetic dyes coming in the second half of the 19th century. (History of Clothing, 2017)

According to a submission by Quatr.us Study Guides (1996), archaeological evidence shows that weaving has been a part of human daily life since the beginning of time. Fragments of very fine linen and woolen cloth have been found in prehistoric graves in countries as far apart as China and Peru.

Plate 1: Pre-Columbian textiles in Cusco, Peru

All members of the family were involved in the production of clothing, rugs and decorative tapestries to provide warmth and inspiration in the home environment whether that was a castle or a tent. Complex designs have been produced on equipment which was often portable, tied to a tree or the mast of a ship to create tension for the weave.

In the 18th and 19th century, weaving in the western world became industrialised causing great social change as family members, including children were employed by the factories. Cottage industry weaving ceased to exist. Today, the industrial production has been transferred to Eastern countries such as China, Korea and India where labour costs are cheaper than in the west. Carpet production is often done by small children whose exploitation is currently under investigation by organisations like the United Nations. In western countries, traditions have been lost and now the same thing is happening in developing countries where the lure of factory work is economically irresistible. By introducing the simple skills of weaving into curriculum work, we can keep our own local traditions alive and introduce other social and creative topics in a very practical way.

Plate 2: Weaving on a crude loom

The art of weaving has evolved over the course of thousands of years, through discovery and experimentation. It involves the production of fabric or cloth by interlacing two distinct sets of yarns or threads in a right angle. The (usually pulled taut) vertical strings are called the warp, and the horizontal thread that is intertwined over and under them is called the weft. The way these two strings are interwoven affects the characteristics of the cloth that will be produced.

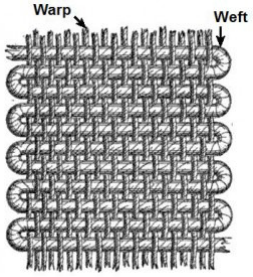


Figure 1: Weave structure

Warp and Weft

Early civilization called for temporary shelters to be built, so knowing how to twine, plait, knot and weave materials such as grass, twigs, string and twine together, in order to build walls, roofs, bedding, baskets and doors, was imperative. The idea of interlacing materials together to create a weave was probably inspired by nature; by observing birds' nests, spider webs and various animal constructions, the early civilization artisans discovered they could manipulate bendable materials and create objects that would make their life easier.

It is believed that man first learned how to create string 20 to 30 thousand years ago, by twisting plant fibres together. This technique evolved through time, and man was eventually able to stretch and dry fibres, in order to produce finer threads.

A distinct fabric impression in an archaeological find (Dolni Vestonice), has led scientists to the conclusion that the discovery of weaving actually took place as early as the Paleolithic era.

Plate 3: An Ancient Egyptian family's clothes

The word *loom* (from Middle English *lome*, "tool") is applied to any set of devices permitting a warp to be tensioned and a shed to be formed. Looms exist in great variety, from the bundles of cords and rods of primitive peoples to enormous machines of steel and cast iron.

Except on certain experimental looms, the warp shed is formed with the aid of heddles (or healds). Usually one heddle is provided for each end, or multiple end, of warp thread, but on some primitive looms, simple cloths are produced with heddles provided only for each alternate end. A heddle consists of a short length of cord, wire, or flat steel strip, supported (in its operative position) roughly perpendicular to the unseparated sheet of warp threads and provided, in modern looms, with an eyelet at its midpoint, through which the warp end is threaded. By pulling one end of the heddle or the other, the warp end can be deflected to one side or the other of the main sheet of ends. The frame holding the heddles is called a harness.

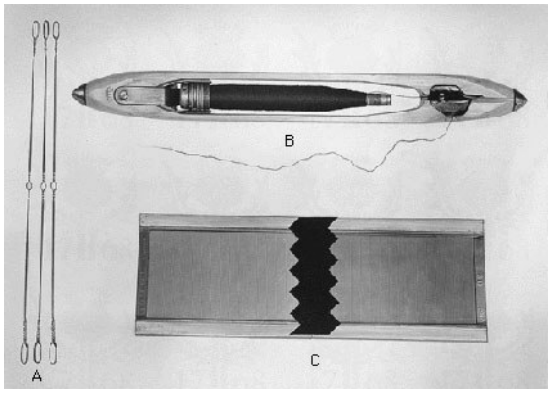


Figure 2: Loom accessories

In most looms, the weft is supplied from a shuttle, a hollow projectile inside which a weft package is mounted in such a way that the weft can be freely unwound through an eyelet leading from the inside to the outside. The shuttle enters the shed and traverses the warp, leaving a trail of weft behind.

2.4 Types of Weaves

According to the submission of Innovateus, weaves can be classified into the following:

The Plain Weave:

Plain weave may also be known as taffeta or homespun weave. To create this weave, the weft creates right angles alternately with every warp. The plain weave can be conducted using two different methods.

- **The baskets weave**: This form of **weaving** uses more than one form of wefts and warps. When conducting the basket weave, as the name may suggest, each group of wefts passes over a parallel number of warps. This will look like crisscross display, as in basket.
- The balanced plain weave: in this type of plain weave, the warp and the weft threads are the same size and type. Even the amount of strands remains the same. This concludes with one-on-one thread crossing of the weft over the warp, making a pattern like a checkerboard.

The Twill Weave:

This pattern has the differentiation between the back and front side. For this type of weave, a single weft strand

passes over one or more warp strands. There is an offset that should be kept between the rows giving it a slanted and ribbed design. An example of Twill weave is the famous denim.

The Satin Weave

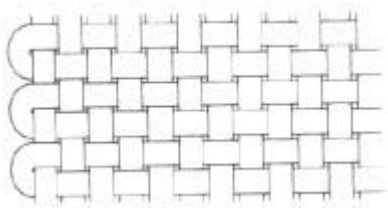
This is one of the most popular of the weaving methods. The satin weave is quite expensive because of its glimmer. During this form of weaving, two or more wefts sit above a single warp which opposes the twill weave. Nowadays, weaving does not only involve the manufacture of fabrics, it uses metals, creating fences and nets, etc.

According to Parmar and Garg (2015), fabrics are manufactured in wide variety of designs. According to them, the different designs and effects are made possible by the help of various mechanisms. These result in weaves as follows:

Plain Weave:

This is the most simple and most common type of construction. It is inexpensive to produce, durable, flat and conducive for printing and other finishes. In this type of weave, each weft yarn goes alternately over and under one warp yarn. Some examples of plain weave fabrics are crepe, taffeta, organdy and muslin. The plain weave may also have variations including the following:

- ***Rib weave***: the filling yarns are larger in diameter than the warp yarns. A rib weave produces fabrics in which fewer yarns per square centimeter are visible on the surface.
- ***Matt Weave or Basket weave***: here, two or more yarns are used in both the warp and filling direction. These groups of yarns are woven as one, producing a basket effect.



Method of Construction: Each filling yarn goes alternately under and over the warp yarns

Household Uses: Draperies, tablecloths, upholstery.

Different types of Fabric Come under this Category;

- ***Chiffon***: A very soft and filling plain woven Silk texture consisting of the finest singles which are hard twisted and woven in the gum condition. The cloth is afterward degummed.
- ***Georgette***: A cotton Crepe fabric made in imitation of silk georgette, with hard twisted warp and weft yarn. A good Cloth is woven plain with right and left twist threads arranged in 2 and 2 order in warp and weft.
- ***Shantung:*** Coarse Silk fabric with Slubs. Mostly, Tussah Silk but can be Polyester, nylon and viscose.
- ***Seersucker:*** It is created by holding some warp yarns at tight tension, some at slack tension. Those at Slack Tension puff up to form a sort of Blis-ter-effect, often slack and tight yarn of different colours.

Basket Weave:

This is a variation of the plain weave usually basket or checkerboard pattern. Contrasting colours are often used. It is inexpensive but less durable than plain weave. Basket weave is the amplification in height and width of plain weave. Two or more yarns have to be lifted or lowered over or under two or more picks for each plain weave point. When the groups of yarns are equal, the basket weave is termed regular, otherwise it is termed irregular.

2.5 Types of Looms

According to *Encyclopedias Britannica*, the word *loom* (from Middle English *lome*, "tool") is applied to any set of devices permitting a warp to be tensioned and a shed to be formed. Looms exist in great variety, from the bundles of cords and rods of primitive peoples to enormous machines of steel and cast iron.

Except on certain experimental looms, the warp shed is formed with the aid of heddles (or healds). Usually one heddle is provided for each end, or multiple end, of warp thread, but on some primitive looms, simple cloths are produced with heddles provided only for each alternate end. A heddle consists of a short length of cord, wire, or flat steel strip, supported (in its operative position) roughly perpendicular to the unseparated sheet of warp threads and provided, in modern looms, with an eyelet at its midpoint, through which the warp end is threaded. By pulling one end of the heddle or the other, the warp end can be deflected to one side or the other of the main sheet of ends. The frame holding the heddles is called a harness.

The modern automatic looms are based on the simple mechanisms of the handloom (hand shuttle loom). In order to understand how an automatic loom works, it is useful to consider the mechanisms of a hand loom. Figure 3 depicts the essential features of a handloom. The following are the key components which control the weaving process.

The warp beam: The beam which the warp is wound onto during warping. As shown, the warp yarns are passed from the warp beam and over the whip beam, through the heddle wires in the shafts, then through the reed and onto the cloth beam.

The whip beam: The whip beam helps to keep the warp yarns under tension as they move from the warp beam

to cloth beam.

The heddle: Also known as 'heald wire', is a looped cord shaped wire with a hole in the middle known as an eye. These wires are attached to a frame known as a shaft. One warp yarn passes through one eye.

Shaft: This is a frame which holds the heddles. The higher the shafts, the more complex the pattern and the lower the shafts, the less complex the patterns.

Reed: Also known as a 'sley' is a device consisting of several wires closely set between two slats. It serves as any or all of the following purposes:

1. Separates the warp yarns.
2. Determines the spacing of the warp yarns.
3. Guiding the shuttle.
4. Beating-up the weft yarn into the fell.

Batten: A flexible device which the reed is attached to, in order for pushing back and forth to create the shed and allow beating-up.

Fell: The line of termination of the woven fabric where the last weft yarn was beaten-up.

Shuttle: A yarn package carrier that is passed through the shed to insert a weft yarn (picks).

Breast beam: Holds the woven fabric under tension and guides the fabric onto the cloth beam.

Cloth beam: The woven fabric is wound onto the cloth beam under tension.

Treadles/Pedals: These activate the movement of the roller above the shafts, alternating the shafts in an up and down motion.

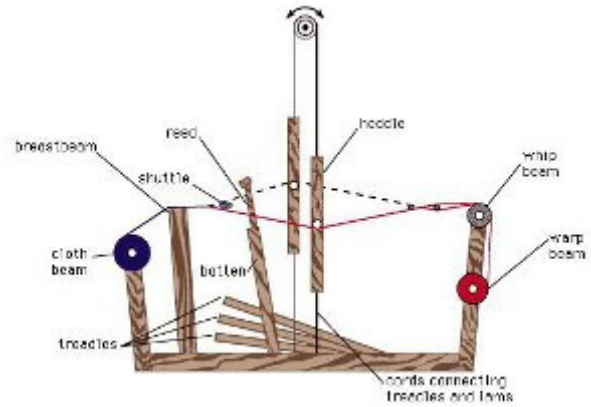


Figure 3: schematic features of the loom

2.51 The industrial revolution and the revival of hand-woven textiles

By the end of the 19th century, the industrial revolution had rendered handicrafts obsolete, since modern machines, like the Jacquard mechanical looms, were taking charge of textile production.

Plate 4: Jacquard Loom

Jacquard mechanical looms

Nowadays, hand-woven fabrics and textiles are appreciated for what they are; unique works of art of unparalleled quality and worth. However, interest in hand-woven textiles was revived during the 20th century, thanks to the Art Deco movement, and folk handicrafts organizations in the US and the UK who taught crafters to be almost entirely self-sufficient.

Kente Loom

The kente cloth is woven on a narrow horizontal wood structure called the Kente loom. A heddle is an integral part of the loom. Each thread in the warp passes through a heddle, which is used to separate the warp threads for the passage of the weft. The typical heddle is made of cord or wire, and is suspended on a shaft of the loom. Each heddle has an eye in the centre where the warp is threaded through. As there is one heddle for each thread of the warp, there can be near a thousand heddles used for fine or wide warps. A hand-woven tea-towel will generally have between 300 and 400 warp threads, and will therefore use many heddles.

In weaving, the warp threads are moved up or down by the shaft. This is achieved because each thread of the warp goes through a heddle on a shaft. When the shaft is raised, a number of the heddles through which the warp threads are threaded are also raised. Heddles can be either equally or unequally distributed on the shafts, depending on the pattern to be woven. In a plain weave or twill, for example, the heddles are equally distributed.

Plate 5: weaving on the Kente loom

Broad Loom

The Broad Loom as the name suggests is broad in structure. It is mostly made of wood or sometimes metal. It has 8 treadles and over five shafts which enable it to weave different types of weave including plain, twill, tapestry and diamond weaves. The Broad Loom has the capacity to weave fabrics that are wide enough to cover the human body without stitching together as in Kente weaving. The wide-width fabrics that are woven on the broad loom are made possible by the long reed. The Pedals are operated by the feet.

Table Loom

The structure of the Table Loom is basically the same as that of the Broad Loom but it has no legs and foot pedals. The heddle frames are operated by hand levers instead of treadles. Even though the same weaves may be produced on the two looms, for broad and long lengths of fabrics, it is better to use the broad loom because it takes a longer time to operate hand levers and also, it is difficult to weave a broad and a long length of fabric due to the size of the table loom. (Adu-Akwaboa, 1994)

2.6 Weaving Processes

The following submissions were made by the Textile Centre of Excellence (2017). According to them, the weaving process consists of five basic operations, shedding, picking, beating-up, left off and take up.

Shedding: Separating the warp yarns into two layers by lifting and lowering the shafts, to form a tunnel known as the 'shed' shown in figure 4 below.

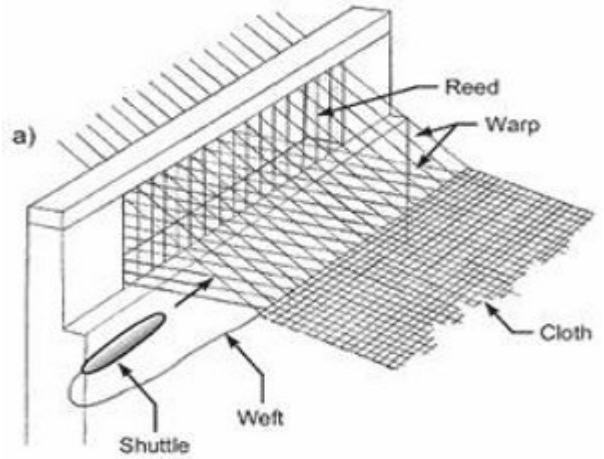


Fig 4: Shedding Motion

Picking or Filling: Passing the weft yarn (pick) across the warp threads through the shed as shown in figure 5 below.

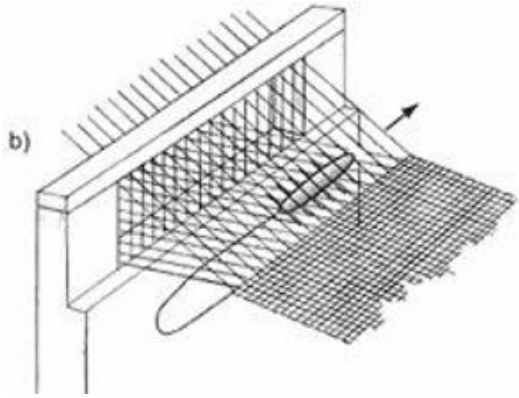


Fig 5: Picking

Beating-up: Pushing the newly inserted weft yarn back into the fell using the reed as shown in figure 6 below.

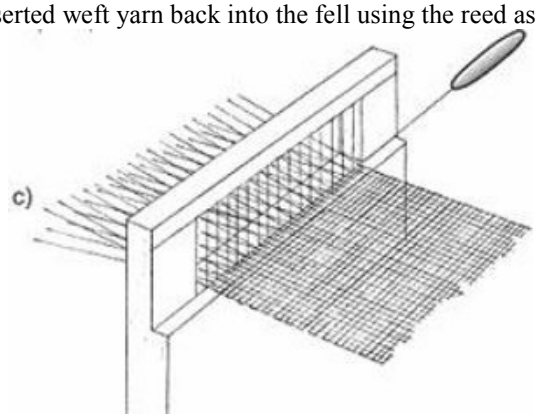


Fig 6: Beating-up

Let off: The warp yarns are unwound from the warp beam during the above three processes. **Take up:** The woven fabric is wound on the cloth beam during the above three processes.

The above operations must be synchronized to occur in the correct sequence and not interfere with one another. The full sequence is repeated for the insertion and interlacing of each weft yarn length with the warp yarns, and is therefore called 'The Weaving Cycle'

According to Rude (2005), the first step in any weaving project is to decide what the cloth's purpose in life will be. The intended function of the cloth guides the weaver in choosing the appropriate thread or yarn. For example, the yarn that is used to weave a rug needs to be thick and hard-wearing, and the cloth must be stiff and flat. It must not roll up at the edges and trip everyone who walks on it, or if it is to be hung as decorative art, it must lie flat against the wall. A scarf, on the other hand, or any cloth worn next to the skin, should be smooth, soft, and very drapery so it conforms to the body.

In all methods of weaving cloth (except the rudimentary form of darning), before a length of weft is inserted in the warp, the warp is separated, over a short length extending from the cloth already formed, into two sheets. The process is called shedding and the space between the sheets is the shed. A pick of weft is then laid between the two sheets of warp, in the operation known as picking. A new shed is then formed in accordance with the desired weave structure, with some or all of the ends in each sheet moving over to the position previously occupied by the other sheet. In this way the weft is clasped between two layers of warp.

Since it is not possible to lay the weft close to the junction of the warp and the cloth already woven, a further operation called beating in, or beating up, is necessary to push the pick to the desired distance away from the last one inserted previously. Although beating usually takes place while the shed is changing, it is normally completed before the new shed is fully formed.

The sequence of primary operations in one weaving cycle is thus shedding, picking, and beating up. At the end of the cycle, the geometrical relation of the pick to the warp is the same as it would have been if the pick had been threaded through the spaces between alternate ends, first from one side of the cloth and then from the other, as in darning. This is the reason why the weaving process is considered an interlacing method. (*Encyclopedia Britannica, Inc.)*

In conclusion, this section of the study presented the views of various authors related to the study. The historical overview of weaving described the origin of weaving and looms from the early days till now. The section also described the different types of looms that exist and their mode of operation. In addition, various

types of weave designs have been described. It is clear from the descriptions that the types of weave designs depend largely on the complexity of the looms. The weaving processes described in this section of the study are similar on all types of looms however, there are slight differences. The next chapter will dwell on the methodology.

3.0 METHODOLOGY

This part of the research discusses the various procedures adopted to collect and synthesize data for the study. It is sub-divided into the following headings: research design, population for the study, sampling technique, data collection instruments and summary of discussions.

3.1 Research Design

Owing to the exploratory nature of the study, the descriptive survey method of research was employed to collect, collate and interpret data. It was adopted practically to describe the various stages of the research. This research design allowed for a systematic and factual presentation of data collected for the study using various statistical methods such as pie charts, bar charts and tables.

3.2 Population for the Study

Sidhu (1984) defines population as the complete set of individuals, objects or events having common observable characteristic in which the researcher is interested. The population for the study includes: 20 textiles students of the department of Fashion Design and Textiles of HTU, 30 textiles students of the department of Industrial Art of HTU, 40 textiles students of selected second cycle institutions in Ho and its environs, 5 textiles lecturers of HTU and 15 textiles tutors of selected second circle institutions in Ho. This sums up to one-hundred and ten respondents (110) as represented statistically in table 1 as follows:

Table 1: Population for the Study

Category of Population	Number
SHS Textiles Students	40
SHS Textiles Tutors	15
HTU Fashion and Textiles Students	20
HTU Textiles Students of Industrial Art	30
HTU Textiles Lecturers	5
Total	**110**

Source: Field Data September, 2017

3.3 Sampling Technique

Due to scarce resources for the conduct of this research, the Random Sampling technique was adopted. Out of a total population of 110, 90 respondents were sampled for the study. This is made up of 45 SHS Textiles students, 21 Textiles Tutors, 12 HTU Fashion students, 9 HTU Textiles students of Industrial Art and 3 HTU Textiles lecturers.

Table 2: Sample Population

Population	Number
SHS Textiles Students	45
SHS Textiles Tutors	21
HTU Fashion Design and Textiles Students	12
HTU Textiles Students of Industrial Art	9
HTU Textiles Lecturers	3
Total	**90**

Source: Field Data September, 2017

3.4 Data Collection Instruments

The data collection instruments used for the study include: questionnaire and observation. The nature of the research topic made the 2 research instruments indispensable.

3.41 Questionnaire

According to Wikipedia, a questionnaire is a research instrument consisting of a series of printed questions for the purpose of gathering information from respondents. It was therefore employed to solicit vital information from the respondents of this study. In all, 90 questionnaire copies were designed and administered to the respondents at prior notice. Luckily enough, all the 90 questionnaire copies were retrieved. The questions bothered on the understanding of respondents about Kente weaving and possible ways of improving upon the

Kente loom to accommodate wider width fabrics such as napkin and table mats. Owing to the heterogeneity of the population, 2 study areas were derived from the sample population. The first study area consisted of SHS Textiles Students and SHS Textile Tutors. The second study area was made up of HTU Fashion Design and Textiles Students, HTU Textiles Students of Industrial Art and HTU Textiles Lecturers. The table below displays the distribution of questionnaires per study area:

Table 3: Questionnaire distribution per study area

RESPONDENTS	NO. OF QUESTIONNAIRES ADMINISTERED	NO. OF QUESTIONNAIRES RETURNED
Study Area 1	66	66
Study Area 2	24	24
Total	**90**	**90**

Source: Field Data September, 2017

3.42 Observation

According to Qualitative Data Analysis, observational research is a social research technique that involves the direct observation of phenomena in their natural setting. This research instrument was therefore used by the researchers to obtain data through direct examination. It involves a critical look or watching carefully on-the-spot the way something happens or someone does something. In observation, the researcher watches and takes notice of what happens but has no active part in it. During the study, we observed that the kente loom was limited to only strips of fabric because of the short reeds and shafts that it uses. It therefore became clear after experimentations that when the reeds and shafts are extended, the width of the resultant fabric will be increased. Hence the decision to embark on this research.

3.5 Summary of Discussions

This part of the study was dedicated to the description of the various research methods adopted for the research. At the end of discussions, it became clear that the study was conducted in a systematic manner. It is therefore expected that logical conclusions will be drawn when the study is brought to a finality.

4.0 ANALYSIS AND INTERPRETATION OF DATA

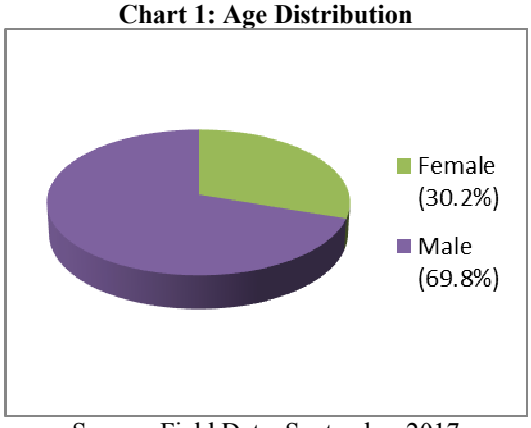
This section of the research paper presents the data obtained for the study using statistical methods such as pie charts, bar charts and tables.

4.1 Demographic Distribution

4.12 Gender Distribution

The pie chart below describes the gender distribution of respondents. It is clear from the pie chart that 30.2% of the respondents are female while 69.8 % are male. This indicates that most of the respondents who take delight in weaving in the study area are male.

Chart 1: Age Distribution

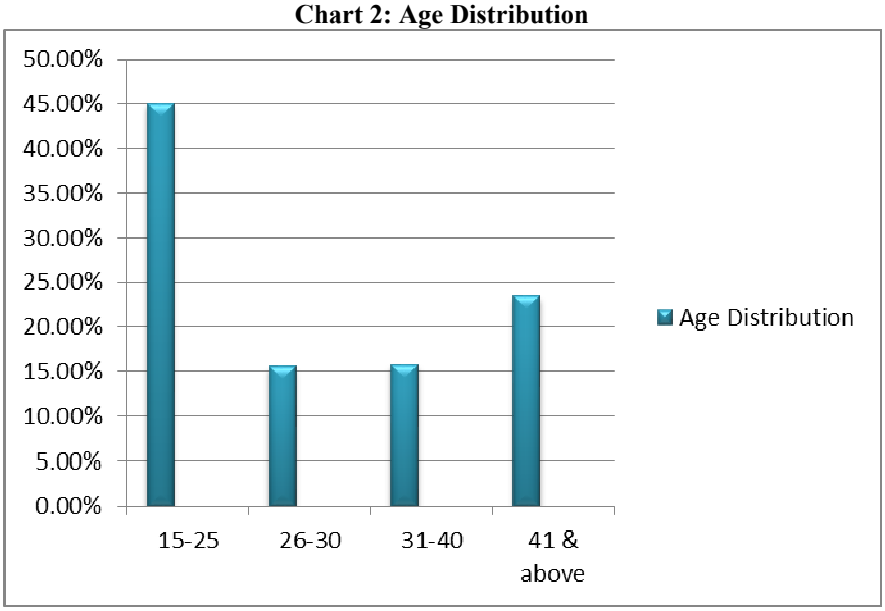


Source: Field Data, September 2017

4.13 Age Distribution

The pie chart below illustrates the age distribution of respondents who participated in the study. It shows that 45.1% of the respondents fall within the youthful age of 15-25 years. This suggests that the youth in the study area are more interested in weaving than the elderly. The chart further reveals that 23.5% of the respondents are within the age bracket of 41 and above which suggests the active participation of the middle aged group in weaving and related issues. Furthermore, 15.8% of the respondents according to the chart are within the age range of 31-40 years while 15.6% of the respondents fall with the age range of 26-30 years.

Chart 2: Age Distribution

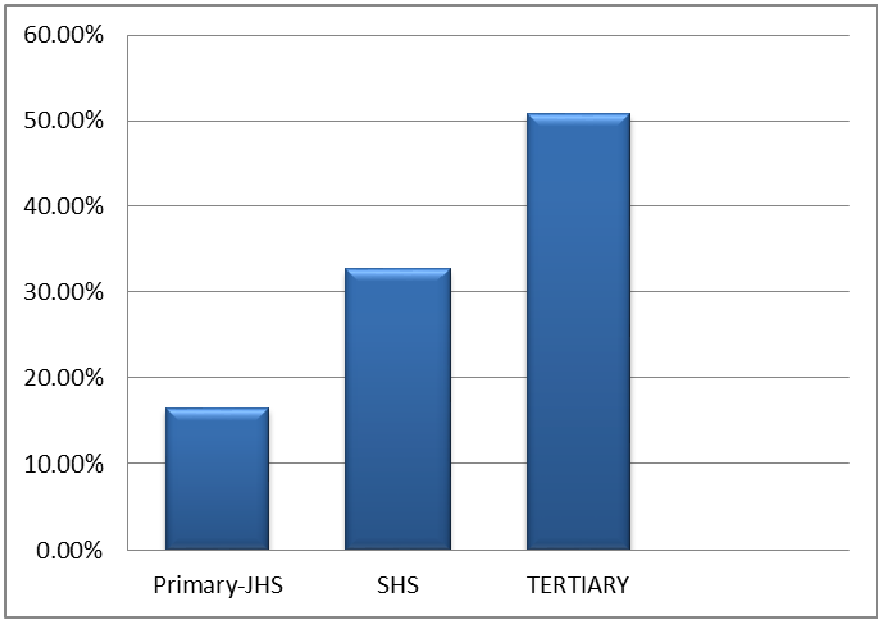


Source: Field Data, September 2017

4.14 Level of Education

Chart 3 below displays the level of education of respondents who participated in the study. From the bar chart, it is clear that as much as 50.8% of the respondents have tertiary education which includes SHS textiles tutors, textiles students of HTU and textiles lecturers. Additionally, 32.7 % of respondents who participated in the study attended SHS while just a handful (16.5%) of the respondents attended primary up to JHS.

Chart 3: Level of Education



Source: Field Data, September 2017

4.2 Rating Respondents' Level of knowledge in Weaving

The table below describes the results obtained after rating the level of knowledge of respondents. From the table, it is clear that 54 respondents representing 60% of the sample population had high knowledge on the topic. Only 4 respondents representing 4.4% of the sample population had superficial knowledge on the subject matter. Meanwhile 19 respondents representing 21.2 % of the sample population had partial knowledge on the topic under discussion while, 13 respondents representing 14.4% of the sample population had low knowledge on the topic. These analyses point to the fact that majority of respondents sampled for the study have adequate knowledge on the topic.

Table 4: Rating Respondents' Level of knowledge in Weaving

Responses	Frequency	Percentage (%)
High	54	60.0
Superficial	4	4.4
Low	13	14.4
Partial	19	21.2
Total	**90**	**100**

Source: Field Data, September 2017

4.3 Assessing Respondents' knowledge on the size of Kente strip

Table 5 below presents results obtained from respondents concerning their knowledge on the size of Kente stip. The results were quite revealing. As many as 53 respondents representing 58.9% of the sample population mentioned 5-7" while 14 respondents representing 15.6% of the sample population gave 45-55" as their answer. Additionally, 10 respondents representing 11.1% of the sample stated 10-20". Also, 8 respondents representing 8.9% of the sample population gave an answer of 20-30". Surprisingly, 5 respondents representing 5.5% of the sample population failed to answer the question.

Table 5: Respondents' knowledge on the size of Kente strip

Responses	Frequency	Percentage (%)
10-20"	10	11.1
20-30"	8	8.9
5-7"	53	58.9
45-55"	14	15.6
No answer	5	5.5
Total	**90**	**100**

Source: Field Data, September 2017

4.4 Devices that determine the width of a woven fabric

The following table displays test results obtained after quizzing respondents about the devices that determine the width of a woven fabric. According to the table, 48 respondents representing 53.3% of the sample population state that a reed determines the width of a woven fabric while 23 respondents representing 25.6% of the sample population mentioned heddle shafts. Also, 13 respondents representing 14.4% of the sample population gave an answer of shuttle. Additionally, 6 respondents representing 6.7 % of the sample population mentioned bobbin.

Table 6: Quizzing respondents on the devices that determine the width of a woven fabric

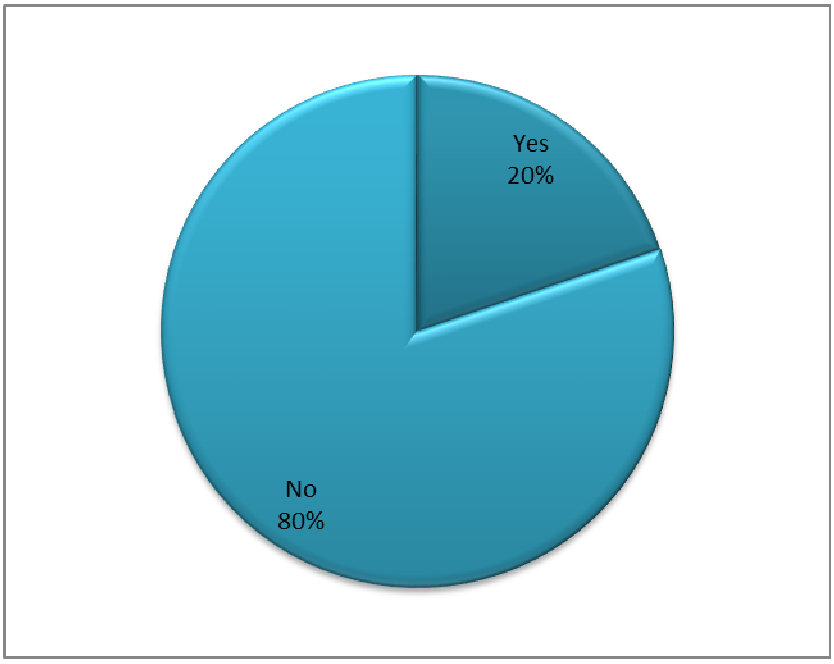
Responses	Frequency	Percentage (%)
Shuttle	13	14.4
Heddle shafts	23	25.6
Reed	48	53.3
bobbin	6	6.7
Total	**90**	**100**

Source: Field Data, September 2017

4.5 Yes or No Responses to the question, "Does the narrow structure of the Kente loom have any effects on the woven fabric?"

The Pie Chart below presents the results obtained after soliciting the view of respondents on whether the narrow structure of the Kente loom affects the width of the Kente strip. The results are as follows: 80% of the respondents did not agree to the assertion while only 20% of the respondents agreed to the assertion.

Chart 4: Yes or No Responses to question, "Does the narrow structure of the Kente loom have any effects on the woven fabric?



Source: Field Data, September 2017

4.6 Assessing respondents' knowledge about the parameters that determine the weave structures that can be produced on the Kente loom

Table 7 below displays views of respondents about the parameters that determine the weave structure on the Kente loom. According to the table, 29 respondents representing 32.2% of the sample population stated Stepping Order and Heddling Order as the parameters that determine the weave structure in the Kente loom. Meanwhile, 24 respondents representing 26.7% of the sample population mentioned Weaving Plan while 12 respondents representing 13.3% of the sample population mentioned Heddling Order. Additionally, 17 respondents representing 18.9% of the sample population were of the view that stepping Order determines the weave design on the Kente loom. Finally, 8 respondents representing 8.9% of the sample population stated Denting Order.

Table 7: Respondents' view on the parameters that determine the weave structures on the Kente loom

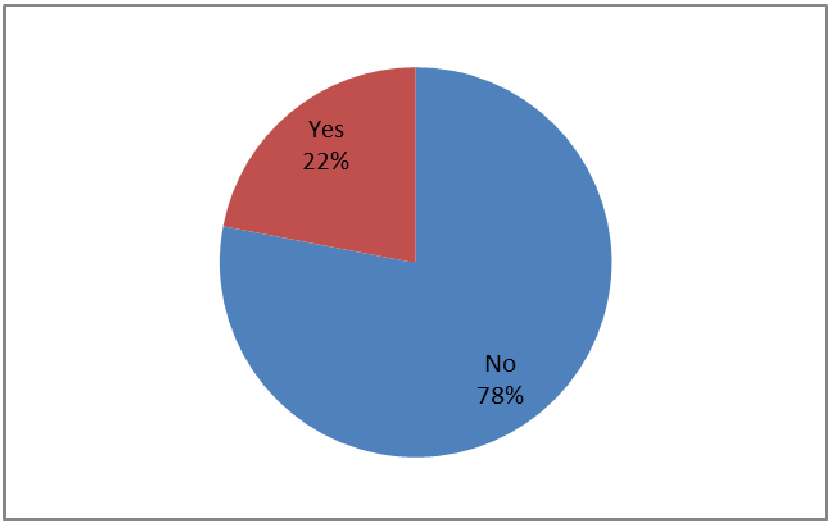
Responses	Frequency	Percentage (%)
Stepping Order	17	18.9
Heddling Order	12	13.3
Weaving Plan	24	26.7
Denting Order	8	8.9
Stepping Order and Heddling Order	29	32.2
Total	**90**	**100**

Source: Field Data, September 2017

4.7 Yes or No responses to the assertion that only strip fabrics can be produced on the Kente loom

Chart 5 below displays the test results obtained from respondents after quizzing them about the assertion that only strip fabrics can be produced on the Kente. The results are quite revealing. After running the test, it came out that 78% of the respondents were not in favour of the assertion while 22% of the respondents responded in the affirmative.

Chart 5: Respondents view on whether only strip fabrics can be produced on the Kente Loom

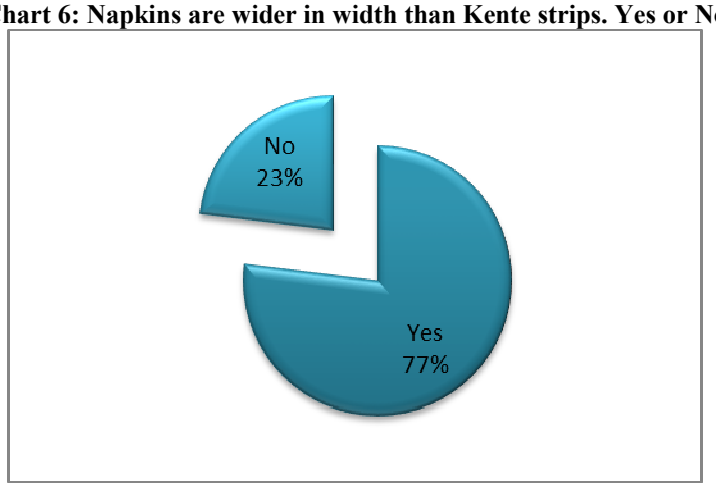


Source: Field Data, September 2017

4.8 Yes or No responses to the statement "Napkins" are normally wider in width than Kente strips.

The Pie Chart below explains that 77% of respondents sampled for the study were of the view that Napkins are really wider in width than the Kente strips.

Chart 6: Napkins are wider in width than Kente strips. Yes or No



Source: Field Data, September 2017

4.9 Responses to the question "what can be done to obtain wider width of fabrics on the Kente Loom?"

Table 8 below presents the results obtained from respondents after questioning them about what can be done to obtain a wider width of Kente fabric. According to the results, 34 respondents representing 37.8% of the sample population said in order to increase the fabric width of Kente, wider reed and heddles could be used while 18 respondents representing 20% of the sample population mentioned the replacement of the heddle shafts. Meanwhile 16 respondents representing 17.8% of the sample population suggested that a larger reed should be used. Furthermore, 13 respondents representing 14.4 % of the sample population just said that in order to increase the width of the Kente cloth, the number of warp yarns and dimension should be increased. 9 respondents were of the view that the size of the Kente loom must be increased and made broad.

Table 8: Responses to the question "what can be done to obtain wider width of fabrics on the Kente Loom?

Responses	Frequency	Percentage (%)
By increasing the number and dimension of the warp	13	14.4
By using a wider reed and heddle	34	37.8
Broad looms must be used in weaving	9	10.0
By using a larger reed	16	17.8
By replacing the heddle shafts	18	20.0
Total	**90**	**100**

Source: Field Data, September 2017

4.10 Weaving on the Kente Loom

The Kent loom called "Nsadua" in Akan and called "Agba" in Ewe language is one of the indigenous looms used in the production of the popular Kente cloth of the Ashantis and Ewes. The Kente loom consists of four upright posts joined together on the sides by four bars. The Kente loom is narrow in structure. Kente is a popular cloth in Ghana produced by the Ashanti and Ewes. It is very colourful and attractive. It is used for durbars, festivals and other festivities. Different interesting designs are produced on the Kente loom by picking. Some of the designs are ***Fathia Fata Nkrumah, Oyokoman and Adwiniasa.***

The Kente loom produces narrow strip fabrics due to the small size of the reed and heddle frames. After producing the Kente strips or what we call stoles, they are joined together by sewing to produce a wider width of fabric. The inconvenience and extra cost of engaging the services of a Tailor or Seamstress to join the strips together can be averted by simply using a wider width reed and a set of heddle frames as confirmed by 37.8% of the respondents in table 8 above. Based on this finding, the researchers decided to embark on this all important study by increasing both the reed width and heddles from 7 inches to 25 and 30 inches. This enabled the production of wider width napkins of about (25 to 30 inches) on the Kente loom.

Prior to weaving, the warp and weft yarns were prepared. The warp yarns were prepared in a process known as warping or warp laying. During the warping, eight long pegs of equal height were fixed to the ground and a set of warp yarns were made to pass round them for crosses to be created. The crosses are needed in the warp for shed creation. The crosses enable the warp sheet to divide into two equal halves when the pedals are depressed.

Plate 6: laying of warp on the Kente loom

After warping, the individual warp yarns were passed through the eyes of the healds on the 25 inch extended heddle shafts according to plain weave heddling order. This was followed by denting where the warp yarns were passed through the dents of the extended reed (25 inches). The reed is a comb-like structure which determines the width of a woven fabric. For the purpose of this study therefore, the length of the reed and heddle shafts were increased as shown in Plate 7 below in order to produce the napkin.

Plate 7: extended heddle shafts and reed

The warp yarns were then tied to the cloth roller for weaving to start. Before weaving, the weft yarns were prepared by winding the cheese, cone or hank onto a bobbin using the bobbin winder. The bobbin was then fixed into a shuttle for weaving to commence. The shuttle is a boat-like structure which contains the weft package and used for weaving. Depending on the number of colours to be woven, one, two, three, four or even five shuttles can be used for the weaving.

Plate 8: winding of napkin onto the cloth roller

Weaving was done by depressing the pedals according to the plain weave stepping order. The shuttle was inserted into the shed at turns. This was followed by beating up of the weft with the beater. The following woven fabrics were produced with different colour combinations as shown in the pictures below.

Plate 9: Specimen of Napkins woven on the Kente loom

5.0 PRESENTATION OF MAIN FINDINGS

The following findings were gathered in the course of the study:

- The narrow structure of the Kente loom does not necessarily affect the woven fabric.
- The Kente loom is limited to the production of only strip fabrics due to the small size of the reed and heddle shafts.
- The fabric width can therefore be increased by extending the reed and heddle shafts.
- The process of joining strips of fabric together is tedious and time consuming.
- Any type of design can be produced on the Kente loom provided the required number of heddle shafts are provided.

6.0 CONCLUSION AND RECOMMENDATIONS

Based on the findings, the following conclusions have been drawn:

Kente is a multi-coloured traditionally woven fabric in Ghana. Its rich colours do not only make the fabric beautiful and attractive but also, they are very symbolic. The Kente cloth is worn by very reputable personalities in the society such as chiefs and queens, presidents and ministers. Apart from this, the Kente cloth is also used in the field of fashion to accessorize bags, belts, shoes and head gears. Despite the fact that the Kente loom is designed to weave only strip fabrics, with little modifications to its mechanisms, other fabric types such as napkins, table cloth, chair backs and handkerchiefs can also be produced on the Kente loom. Additionally, all other weave designs including plain weave, twill, and sateen weaves can be woven on the Kente loom provided the necessary modifications are effected. The modifications for weaving wider fabrics include extension of the heddle shafts and the reed which was the main focus of this study. The modifications for weaving other designs on the Kente loom involve the increase in the number of heddle shafts from 4 to 8 depending on the type of weave. Considering the relatively high foreign exchange derived by the State from the exportation of Kente, it is necessary for the stake holders in the weaving industry of Ghana to invest into revamping the sector. The Kente loom must be modernized and if possible mechanized to ensure efficiency and quality. Also with the mechanization of the weaving process, the rate of production will increase drastically and that implies increased production and more revenue.

REFFERENCES

[1] Adu-Akwaboa S. (1994), *Art for Schools and Colleges* (Revised Edition), Kumasi, Samarg Puclication.
[2] InnovateUs (2006), *Different types Weaving,* pp13-20
[3] Textile Innovation (2017), *History of Clothing*
[4] Textile Centre of Excellence (2017)
[5] Gbadegbe etal (2014), *Extraction of Dyes from Natural Sources: an Implication for Exploring Millet,* International Journal of Humanities $ Social Studies, pp1
[6] http//Wikipedia.org/wiki/weaving. Retrieved 18th September, 2017.
[7] Rozentals (2017), *Weave Design*
[8 Rude (2005), *Weaving: The complete Process From Thread to Cloth*, Textile Artist Three Spring
[9] Sidhu (1984), *Methodology of Research in Education*