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Appraisal Of Works Produced By Metal Products Design Students Of Kwame Nkrumah University Of Science And Technology (Knust), Kumasi, Ghana

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Abstract:

Metal Products Design Program (MPDP) was introduced in Kwame Nkrumah University of Science and Technology in 1964. The establishment of the MPDP was to contribute to effective utilization of precious and non-precious metals in Ghana. In Ghana, the MPD has many functions which have contributed a lot in our society, for instance, from our traditional to modern homes, we see metal products. Again institutions such as churches, hospitals and other organizations also make judicious use of metal products. Individuals and functional leaders like chiefs, security officers and religious leaders do the same. Some of the metal products that one can talk about in the Ghanaian community include saucepans, tea strainers, tables, jewellery, coal pots, forks and many others. It is obvious to note that a metal product is now one of the major contributors to all areas of human needs. This study aimed at investigating and appraising works produced by students of Metal Products Design Section of Faculty of Art, KNUST to ascertain the strengths and weaknesses of works of students and the future direction of works to be produced by students of the section in Ghana. The objectives of this study are to: (1) identify and describe selected types of works produced by students of MPD section, (2) discuss the sources of ideas, processes, tools and materials and equipment used to produce these works and (3) appraise selected works to ascertain the strengths and weaknesses of them. The data for the study were collected from both primary and secondary sources. The primary sources of data were gathered through administration of questionnaires to students from year two to year four and the lecturers of the Metal Products Design Section. The secondary sources were from books, journals and internet. Selected works of students from the year 1999-2009 were purposefully sampled and appraised. The study discovered the significance of Metal Products Design in our society. It identified what makes up the Metal Products Design and the type of works produced at the section. The study recommended immediate introduction of industrial attachment and welding as a major course for students, improving of equipment and tools, increasing lecturer per student ratio and upgradation of the Section to a departmental status.

Keywords: Metallurgy, Malleable, forging, Welding, Alloy, Electroplating

1.Introduction

The need to improve metal products design in the country necessitated the study of works produced by the students of MPD section to educate the public about works of students, what the works of students entails and the future direction of students' works in the economic development of Ghana.

Metal Product Design (MPD) as the name implies, is a division of knowledge, which deals with the general designing and how to put that design to use in metal or integrate metal. More individuals than ever before are learning metalworking as a creative outlet in the forms of jewelry making, restoration of aircraft and cars, blacksmithing, tinsmithing, tinkering, and in other art and craft pursuits as explained by Palmer (2007).

The numerous metals that are used for metal products include gold, silver, copper, brass and aluminum. McCreight (1991) attested that gold was the first precious metal to be worked on by man, being available as nuggets that required no smelting. Because of its rarity and lustre and the ability to resist corrosion, it has been valued by many cultures in Ghana and across the world. Ayensu (1997) also elucidated that gold is the commonness precious metal used in Ghana. Gold forms the core nature of Ghanaian jewellery and wealth. Indeed gold articles are found extensively in antiquity mainly as jewellery, e.g. bracelets, rings etc.

Another precious metal used for ornamental purpose similar to gold is silver. According to McCreight (1991), silver was known in the ancient world as argentums, and was held to be more precious than gold because it appeared less commonly in nature. In Ghanaian culture silver places second to gold, so that in Ashanti kingdom the King, Otumfour Osei Tutu II who is the Ashantehene sits on the golden stool while the Mampong hene Daasebre Osei Bonsu sits on the silver stool whereas Ofinso hene, Nana Wiafe Akenten III, third in command sits on bronze stool. McCreight (1991) and Bray (2003) again argued that copper is relatively abundant, easily mined and extremely versatile in its many applications. Copper has a long history and has been used by many cultures for centuries. It is used for decorative metal works, frames, jewellery, utensil and many others.

Brass is an alloy of copper and zinc, a combination that yields a yellow metal that is tougher than either of its components. Brass is widely used because of its malleability, machinability and its resistance to corrosion. It serves the purpose of jewellery, decorative works, and machinery (McCreight,1991; Bray, 2003).

They explained that aluminum is the most abundant metallic element on the planet, making up 8% of the earth's crust. Because of its resistance to corrosion, light weight and low cost, aluminum is used in architecture, house wares and packaging.

The research reveals that fabrication and finishing were the two major processes that the students used in fashioning their works. Casting, chasing, forging, piercing, bending fusing, riveting and many others were the fundamental fabrication processes employed by students. McGrath (1995) defined casting as a technique by which it is possible to create shapes that would otherwise involve an enormous amount of waste. There are three main methods of casting. These are cuttlefish casting, lost wax casting and rubber mould casting. Students employed all these techniques in fashioning their works.

McGrath (1995) explained chasing as the art of controlling small steel tool to push the lines of a pattern along the surface of the metal. This creates design both inside and outside of the metal sheet. This method was often used in cases where complicated designs were required.

Every metal that is designed undergoes forging. It therefore makes forging the most fundamental process that metal passes through to become a finished product. McGrath (1995) noted that forging is a way of stretching, flattening, curving and shaping metal by applying force from different directions by means of specially shaped hammers, which are used from the top while the metal is supported on stakes of various shapes or on an anvil. In metal product design the processes mentioned by McGrath are evident in them.

Murphy (1993) attested that piercing is the means of punching of holes of any shape in the blank, and is sometimes done before punching out the blank from the sheet or strip, and sometimes afterwards, according to the varying circumstances. Piercing is another important process of metal fabrication. It allows creation of holes for design and joints. Again it is a means of cutting metal into sizes for decoration.

Murphy also indicated that bending refers to one or more plain bends, whether curved or with sharp corners. When bends are numerous or complicated the operation is known as forming. In fact, forming covers a multitude of shapes such as indents, recesses, channels or curves into which the work may be bent.

According to Bray (2003) there are four basic ways of joining metal sections together – they can be riveted; screwed or bolted; or joined by some means of soldering or welding; or stuck together, something that our grandfathers would have thought to be impossible.

McGrath (1995) connoted that fusing is a process that metal can be joined without solder by simply heating it to the temperature at which it starts to melt. As the surface of the metal begins to move, any areas that are touching will fuse together.

Riveting being one of the joining processes in metal work production was defined by McGrath (1995) as a useful way of joining pieces of metal with another piece of metal, wood or plastic.

Finishing is the final process that metal products go through before they are marketed. McCreight (1991) elucidated that etching is the process whereby chemical rather than mechanical force is used as metals are given controlled exposure to acids for specific durations to create the desired effects. According to McGrath (1995) etching is the use of an acid solution, known as a mordant, to dissolve away exposed sections of metal. This can be done to create a design. Protective clothing and ventilation are required. This technique in some instances forms part of finishing processes in metal product design.

Repousse is an ancient process that gives form to a sheet of metal by pressing it out from the back and in from the front (McCreight,1991). Repousse' is the art of working with punches from the back of an article to form shapes and lines that give your work a three-dimensional appearance when it is viewed from the front. In addition, range of punches apply on a repousse work depends on the plasticity of a supporting material that holds the work metal.

In electroforming, conventional plating deposits a thin film of metal onto the surface of an otherwise finished piece of work (McCreight, 1991). Electroforming uses this technology to build up a substantial layer of metal, often on a matrix of a non metal such as other metal, wood and plastics. So that brass metal can be electroformed with gold metal and silver electroformed with gold or copper metal to serve a required purpose.

Enamel is a unique and storical way of using colour to enhance metal work. Enamels are a mixture of silica, lead oxides, salts of soda, potassium and boric acids, which fuse to a copper, steel, silver or gold surface when they are fired in a kiln (McGrath, 1995). There are three types of enamel: transparent, opaque and opalescent. Students mostly use the opaque enamel as compared to the other two types of enamel. McGrath (1995) also explained engraving as other finishing process of metal product design. He defined engraving as the art of removing surface metal to create a decoration.

Although an extremely good finish can be obtained on any metal by the correct use of a file, particularly one of the very smooth range, many people prefer to do their final finishing with abrasive that can be used in a machine and can save a lot of work.

Abrasives are generally used in the workshop in the form of paper and cloth, on which there is a coating of tiny particles of material that are very sharp (Bray, 2003).

2.Tools And Materials

This research ascertained the source of materials used for the works to include sheet of ferrous metals and non-ferrous metals. Ferrous metals include iron and steel. Non-ferrous metals such as silver, copper, brass and aluminum were the basic materials used in items produced. Also materials such as wood, cloth, synthetic gemstones, glasses, foam and turpentine solution were sometimes used to integrate production. In an area of etching, hydrochloric acid, sulphuric acid, nitric acids were used.

Tools used were soldering torch, pliers, hammer, hand files, jewellery saw blade, jewellery saw frame, tweezers, chasing tools, chasing block, emery paper, tripoli and rouge. Others included scratch brush, mallet, shears and metal rulers. Equipment used included milling machine, furnace, drilling machine, polishing machine, anvil, bench vice and guillotine machine.

3.Methodology

The qualitative research approach was used for the study because it allowed for detailed description of activities performed by producers of the works (Denzin & Lincoln ,2003).

In other words qualitative descriptive research method was employed for the study.

Qualitative descriptive research was used to describe the works produced and their qualities. Also, to ascertain the processes that students go through to produce their works and how students fabricate and finish their works. The researchers recorded, described, analyzed and interpreted findings and conditions in line with the works produced by students of the MPD section.

The target population for the study was students and lecturers at the MPD section. But it was practically impossible to get all members in the target population so purposive sampling method was employed to select 28 second year MPD students, 26 third year MPD students, 24 fourth year MPD students and 6 MPD lecturers, making the total sampling population of 84 for the study.

To be able to collect cogent data from the sample population, questionnaire, interview and observation were utilized. According to Given (2008), interview is an approach used by the researchers to generate verbal data through talking about specific topics with research participant in an informal and conversational way. Best (2002) affirmed that

observation is used in qualitative research and it springs out detailed notation of behaviours, events, and contexts surrounding the events and behaviours. Copies of questionnaire were administered to respondents; a fellow-up one-on-one interview was also conducted among only lecturers and observation was employed to obtain a firsthand information and ascertain the truth to avoid biases and falsehood. Photographs of works produced by students of MPD section were taken. A total number of 51 pictures were taken. These pictures were mainly selected finished works of MPD students. Only the pictures relevant to the study were assembled, described, analyzed, interpreted and conclusions drawn and recommendations made.

4.Results And Discussion

4.1.Students' Works Under Discussion

This research ascertained the source of idea, originality, and composition of all the elements and principles of design in the works, processes used, craftsmanship and findings. The works have also been fully appreciated.



Figure 1: Pendant(2006)

Figure 1 is a pendant designed and produced by students' of the year 2006. The work measures 3.6cm x 1.5cm and can be found in the collection of the MPD section of KNUST. Source of idea for the work was developed from the shell of a snail. The work in this Figure is original because it has added to the already existing metal work. It was

composed based on elements and principles of design such as line, shape, texture on surface of the work and colour of the material (silver).

Silver was the main material for this work. In fabricating the pendant tubes to hold the gemstones and the hook on top of the pendant were soldered together using solder and borax. Synthetic gemstones were set on top of the pendant. Tools such as soldering torch, round nose pliers, hammer, hand files, jewellery saw blade, jewellery saw frame and emery papers were used. Equipment used included milling machine, polishing machine, buff machine and furnace.

Molten metal in a crucible was poured and then formed into an ingot. It was then rolled in a milling machine to the desired thickness. According to design, piercing was done to bring out the shape of the work. The pendant holder was fabricated through milling of silver for it to be flat and cutting the required shape. With the aid of round nose-pliers, the cut sheet of silver was soldered at the joint over a loop connected to the pendant. Tube forming technique was employed to form a tube in which the synthetic gemstone was set. The finished work was pickled and polished with polishing machine, emery papers, tripoli and rouge.

There is variety of dynamic volumes and shapes created in the pendant which enhances visual harmony. The component parts are well defined and the entire composition lies symmetrically in balance and unified position which heightens the sense of unity. Aesthetically the work looks attractive and unique.



Figure 2: Head crown (2004)

Figure 2 is a Headcrown fashioned and produced by students' of the year 2004. The dimension of the work is 13.9cm x 12.7cm and it is found in the collection of the MPD section of KNUST. Source of idea for the work was symbolically deduced from Adinkra

symbols and leaves. The work in Figure 2 is a novelty because it has added to the already existing metal works. The composition was based on elements and principles of design such as lines, shape, texture, colour, variety, emphasis, contrast and rhythm and balance.

Brass sheet was used for the work. Gemstone was set in created slot. Borax and solder were used as joining material. Tools used included jewellery saw frame, jewellery saw blade, soldering torch, gem setting tools, measuring rule, mallet, tweezers, hammer, hand files and emery paper. Equipment used included Anvil, polishing machine, milling machine, guillotine cutting machine and furnace.

Brass metal sheet was annealed, milled through the roller to get a required thickness and prepared design paste on it and pierced. Anvil was used to curve pierced brass sheet to fit the head of wearer. Projected areas were chased using chasing tools. Tube forming technique was employed and gemstone set. The work was finished and polished with polishing machine, buff machine, emery papers, tripoli and rouge.

It is precise, well executed and harmonises very well. The shape of the work is finished to serve its purpose. The basis of this headcrown is the repetition of similar units linked into each other to form a much fastened strand of dramatic flow. The distinctiveness of the units add a touch of elegance and aesthetic appeal to the headcrown. The work in totality is aesthetically pleasing and intriguing.



Figure 3: Light scorn shade (2006)

The light scorn shade in Figure 3 is a copper work executed by MPD students' of the year 2006. It measures 40.3cm x 27.6cm and can be found in the collection of the MPD section of KNUST. The composition is a semi-abstract & realistic representation. It depicts an eagle with an opened wing. The originality of the work is in the techniqueness applied to execute the work.

The design composition which included a good combination of lines, shapes, dots, texture and variety, balance, rhythm, contrast and emphasis helped to bring out the beauty of the work.

Copper, borax and solder were the materials used. Tools used included carved wood, chasing tools, jewellery saw frame, jewellery saw blade, soldering torch, mallet, hand file, tweezers, hammer and emery paper. Equipment used included anvil, polishing machine, milling machine, guillotine cutting machine and furnace.

Copper Figure was prepared and annealed to spread on a carved design board of wood and fixed with nails. Chasing and embossing were the main techniques used to project the work out of the copper sheet. The finished work was pickled and polished with emery paper, tripoli and rouge using polishing machine with buff.

The work is properly put together in the capacity as a light scorn shade. It is precisely organized and serves its purpose. The work is symmetrically balanced with varied lines, shapes, space and forms help in creating special interest, harmony, rhythm, movement and dynamic effect in the overall structural design. The sense of viewing the work agitates beauty. It is attractive, pleasing and nice and could be used to decorate the home or office.



Figure 4: Aluminum and brass wall clock (2005)

Figure 4 is an enhanced aluminum and brass wall clock produced by students' of 2005 year group of MPD section of KNUST. It measures 43.4cm x 37.1cm and is kept in the MPD collection of KNUST. The source of idea was from the sun, when it is scorched. Although the motif is not new the composition of the elements of design and principles of design with human activity makes the work original.

Brass, aluminum, solder, and borax were the materials used. Tools such as soldering torch, round nose pliers, mallet, chasing tools, chasing block, carved wood, hammer, hand files, jewellery saw blade, jewellery saw frame and emery papers were used. Equipment used included milling machine, anvil, guillotine machine, and furnace.

A required thickness of aluminum sheet metal was annealed and spread to cover a carved design wood board and held firm with nails for chasing. Chasing was done to raise the metal up. Certain areas were embossed to a big projection and the sides chased for detail. Intricate areas were pierced out including numbers on the clock. Soldering was used to weld numbers to parts of the work. The finished work was polished with emery paper, tripoli and rouge.

It is precise and possesses a good combination of elements and principles of design. The shape of the work is well finished, overlapped and arranged to suit the user.



Figure 5: Wall hang (2007)

Figure 5 is a wall hang fashioned and produced by students' of the year 2007. Its measures 73.8cm x 59.7cm and presently located in the collection of the MPD section of KNUST. The source of idea for the above work came from the society settings which looked at domestic violence. The originality of the work is in the composition of the materials and the organization of the elements and principles of design.

Aluminum, card, cloth, foam, sand, glue, straw and wood were the materials used for the work. Tools such as soldering torch, pliers, mallet, hammer, hand files, jewellery saw blade, jewellery saw frame and emery papers were used. Equipment used included guillotine machine, anvil and furnace.

Aluminum sheet was molded to form the buildings. Straw materials were employed to roof the buildings. The human beings were molded with plastic or gum rubber to perform an activity. Annealing, and milling were the processes employed in this production.

There is variety of dynamic volumes, space, and shapes created in the wall hang which enhances visual harmony. The component parts are well defined and the entire composition lies symmetrically in balance and unified position which heightens the sense of unity. The colour combination of the work is well blend bringing emphasis on various elements and principles of design. The work is well designed and carefully finished. It makes good use of different materials to educate the public.



Figure 6: Filigree metal sculpture (2009)

With the measurement of 110.5cm x 69.7cm, the filigree metal sculpture (see Figure 6) is a work finished by MPD students' in the year 2009. The work can be located in the collection of the MPD section of KNUST. The composition is a realistic representation. The source of the idea for the work in Figure 6 was derived from butterfly and flower. The composition of the elements of design and principles of design is quite good. Although the design may be common, its application of elements and principles of design organization has made it unusual.

Iron sheet, iron rod, paint and iron wire were the materials used for the metal work. Tools such as pliers, mallet, hammer, and hand files were used. Equipment used included hand spraying machine, welding machine, anvil, milling machine, guillotine and furnace.

Iron rods were forged to fit the finished design. Some twisted and weaving techniques were also applied. The finished work was sprayed in different colours.

The work is symmetrically balanced with varied lines, texture, shapes, space and forms that help in creating special interest, harmony, rhythm, movement and dynamic effect in the overall structural design. It is complicated but precise and possesses rare and interesting aesthetic qualities.



Figure 7: Coffee Table (2007)

The measurement of the work in Figure 7, is 40.9 cm x 30.6 cm. It is a collection of the MPD section of KNUST produced by students of the year 2007. The beautiful work is developed from Adinkra symbols. Although the motif is not new to the Ghanaian culture, the elements and principles of design composition makes the work unique and original. Iron square pipe, iron rod, tinted glass and paint were the materials used for the metal work. Tools such as pliers, mallet, hammer, and hand files were used. Equipment used included welding machine, anvil, milling machine, guillotine and furnace. Forging, twisting and weaving techniques were applied. The finished work was sprayed using graffiti spray.

It is simple, precise and possesses a good combination of elements and principles of design. The work is well executed, good finishing and aesthetically appealing.



Figure 8: Straining spoon (1999)

Figure 8 is a straining spoon fashioned and produced by students' of the year 1999. The dimension of the work is 30.8 cm x 8.7cm and its found in the collection of the MPD section of KNUST. The source of the idea for straining spoon was influenced by foreign designs. Originality of the work is questionable because of its commonness. Composition of elements and principles of design were less emphasized.

Stainless steel, solder and borax form the materials used. Tools such as soldering torch, hammer, hand files, jewelery saw blade, jewellery saw frame and emery papers were used. Equipment used included milling machine, anvil and furnace.

Processes such as piercing, soldering, annealing and milling were applied to the work. The finished work was polished with emery paper, tripoli and rouge. The technical and finishing of this work leaves much to be desired. The work looks aesthetically pleasing but much is not seen about elements and principles of design.

4.2. Classification Of Students' Works

Designing process according to Amenuke (1995), Amenuke et el (1991) should start from identifying the problem, defining and specifying the problem, investigating the problem (research and analysis), suggesting possible solutions, model, prototype, drawings, production (making the article) and finally appraisal of them.

Inferring from the above works of students of metal section, works could be identified with some if not all the processes involved in designing. Based on the study and in reference to the data gathered, students' works at the section could be grouped into four categories. These groups are:

- Jewellery work (Figures 1 and 2): These are works that students fashion mainly with precious metals like silver and to some extent brass and copper. These

works are body decorated metal products which are named based on the part of the body it is going to be used on. They have tiny features and are smaller in size and it can be easily folded or put to one's comfortable place. Examples are earring, finger ring, necklace just to mention a few.'

- Decorative work (Figures 3 and 4): Works in this category are the ones that students fashion mostly to decorate walls in a room and other parts of the room, offices and homes. These kind of works are sizeable enough. Metals like copper, brass, aluminum, stainless steel are used in fashioning these kinds of works. Examples are mirror frame, light sconce, lamp shade and flower vase.
- Metal technology work (Figures 5 and 6): This group of work is the type that combines metal with other materials. It also employs scientific processes that enable it to serve a lot of functions. Materials used in these kinds of works are aluminum, copper, brass, galvanized metal sheet, iron rods, wood, enamel, paper card, cloth, foam, rubber gum, sand, oil paint and tiles. They are colossal in size and can be used almost everywhere in our environment.
- Furnishing work (Figures 7 and 8): The last group of works are those fashioned basically as utilities. They are the works that fall outside the jewelry, decorative piece and metal technology. They serve the purpose of center table, utensil, resting chairs and furniture among others. Works in this group make use of welding and soldering as the two main techniques of joining. Iron rod, stainless steel, copper, brass, transparent and tinted glass and wood are the main materials used. This group of works is colossal than all the others.

The study of works produced by students pointed out that, students get their ideas from nature, man-made environment, symbolic forms and wise sayings and themes, dreams and internet.

The most used working techniques include embossing, chasing and piercing. The joining processes are soldering and welding. The metals common to the section of which students use for their works are aluminum, brass, copper, iron rod and stainless steel. Although students' works identify problem, some of the works are not solving the problem accurately. Some of the works also lack ideas and good finishing.

5. Conclusion

The demand for metal products in this economical dispensation call for innovational promotion of the metal industry in Ghana. It is in this regard that the research was conducted to ascertain the “whats,” “hows”, “wheres” and “whys” of metal production in Ghana specifically Metal Product Design in Kwame Nkrumah University of Science and Technology, in Kumasi.

Although Students of MPD section produce different types of works, jewellery remain a largely produced work. It therefore means that the MPD section is jewellery oriented. Students’ sources of ideas are good but due to lack of tools and equipment, students cannot explore most of the basic techniques such as forming, cutting and joining processes. Courses of the MPD do not really emphasize industrial attachment, welding and managerial skills. Paying less attention of these courses is posing a big challenge for students in producing their works. The basic metals such as silver, brass, copper, and aluminum have become too dominant limiting student’s metal exploration.

Student’s attitude towards the program also affects their work. Some students have little or no knowledge about the MPD. This changes the attitude of students to develop interest when they are faced with facility problems. The number of lecturers compared to the number of students is one to twenty- two approximately. The MPD is basically a practical program and the number of lecturers in relation to students makes supervision not very effective. Students’ works most likely have poor finishing standards and not too aesthetically pleasing and that is why they are uncompetitive to the foreign products.

6. Recommendation

The researchers recommend that lecturers and technicians of MPD section should improve and widen the range of practical works assigned to students. The use of nature in developing ideas must be kept and fused with themes and cultural values. Equipment and tools should be improved.

Courses of the MPD must be upgraded to improve industrial attachment, welding and managerial skills. Qualified persons in those fields should be considered as lecturers and technicians in those areas. Other forms of metals should be explored for students’ works. There should be a video documentation of all the practical courses to teach students even when lecturers are or not in class to broaden the practical knowledge of students before they start practical work. This would reduce the supervision time for lecturers. Last but not least, the MPD section should be given a departmental status to enable the section

stand independently to secure necessary tools, equipment and infrastructure that would enable the students to produce more quality and competitive works.

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