

Technical developments in the formation of acrylic sculpture and methods of processing it by printing in the development of small productive projects for art students

Mahmoud Mostafa El Sayed

**Assistant Professor of Sculpture, Department of Art Education,
Faculty of Specific Education, Alexandria University**

Abstract:

Background search:

Technology has become a necessity required by modern-day variables, where technology helped to develop many of the machines and equipment used by the sculptor, which had an impact on the speed of completion of his sculptures, and acrylic is one of the materials of plastic that can be formed directly, thermally or morphologically by pouring it into sculptural molds, and the acrylic material was used as a sculptural ore in the 20th century where naoum Jabo and Moholi Naji, two pioneers of the building school and interested in the formation of the hares In addition to the direct formation of acrylic panels and slices in the carving of transparent sculptures and the cradle of the appearance of transparent sculpture, the use of this material by sculptors has led to its plastic capabilities and properties related to transparency and its interference with light led to the realization of new sculptural values.



Form (1) Naoum Jabo, Acrylic

Shape (2) Maholi Naji, 1946, Acrylic

<https://www.are.na/block/1298554>

Acrylic is one of the plastic materials that can be reconfigured by thermoplastic heat, a material with characteristics that make it suitable for vacuum expression in ways different from other materials, it is highly transparent and is considered one of the most transparent plastics and has high permeability of light to the point of superiority of glass at times, and is characterized by its ability to attract light, so the artist can use the light that is influential through this material as a formative element that achieves new formative possibilities that add other dimensions. For vacuum expression, colored light can be introduced as a moving element into the sculptural work by controlling its paths, grades and rhythms.

Plastic ore is an advanced product in the twentieth century and has become widespread and widely used as a result of its experiments and practical processes with the aim of developing and improving the sensory and synthetic properties of the opacity, and man has resorted to using them as an alternative to other expensive, perishable and degradable materials, which has made many accept the benefit of these important properties.(Mohammed Ismail Omar, 1998, p. 5) So we look forward through the current research to trying to employ acrylic material in sculpture in contemporary composition using the appropriate new technology.

Key Words:

Technical developments, acrylic sculpture, art students

Introduction:

Search problem: The search problem can boil down to the following question:

- How to benefit from the intellectual and technical developments of the sculptural formation of acrylic ores and ways to process it in nature by heat transport (Decal) And to benefit from it in the development of small production projects for art scholars?

Search objectives: Research aims to:

1- Find innovative methods and methods of formation that enrich the field of contemporary sculpture by taking advantage of the possibilities of acrylic plastic material.

2- Revealing the plastic values and the aesthetic values of the sensory and synthetic properties of acrylic opacity in the field of modern sculpture.

3- Learn about the possibilities of acrylic material and subject it to plastic requirements to make it accessible to the artist.

4- Bachelor's students have some experience in managing small production projects.

Research Muslims:

1- The industrial revolution and technological progress helped the sculptor produce his creativity and freedom from the traditional form.

2- Transparent sculptural forms have their theories that determine their form and content.

Search assignments: The research assumes the following:

1- There are new ways to use acrylic in the formation.

2- Limiting the techniques and plastic methods of acrylic to modern sculpture to use in the field of sculpture teaching.

3- To come up with new techniques related to the manual and automated applications of acrylic ores and to process them in print by heat transport (Decal).

The importance of research:

- Learn about the plastic and expressive values of the Aquatic aunt as a source of enrichment of stereoscopic expression in the field of sculpture.
- Highlighting the role of scientific and technological development in finding various solutions and treatments using acrylic material.
- Reveal the sensory and compositional properties of the composition of the aqueous opacity in terms of transparency, darkness, multilocation and tolerance of various stress stresses and weather factors to employ them for the benefit of stereoscopic artistic expression.
- Contribute to providing solutions to eliminate unemployment and exploit the experiences and possibilities of young people

Search terms:

1- Acrylic ore: Acrylic is one of the materials of plastic plastics with heat that has a lot of characteristics of glass, and most acrylic plastic is made up of polymethylal polymer and acrylic can be formed directly using the number of tools and machines sculpture or thermal formation or poured into sculptural molds, can be welded or glued using different labels and can be recycled and formed again without any change.

The nature of acrylic: It is a plastic material that is thermally reconfigurable, it acquires a rubber state when exposed to heat and heating, can be formed in many forms by pressing, lying or making forms by conducting or welding. Leave after heating to harden again without any cracks, and can be heated many times without any change. (<https://e3arabi.com>).

2- Decal technology: "Decal technology is to reproduce images and decorations in a way that can be repeated using color printing technology so that these decorations can be applied over different pieces or flats, and the technique of decal is often used in the decoration of round or irregular shapes that are difficult to convey color or print directly" (Hassan Rashid Abdul Aziz, 2006, p. 194), so we first print designs or pictures on decals and then transfer these designs from paper to paper to paper Pieces.

3- Transparency: The word "transparent" is contained in the dictionary "in the sense of slavery, and it appears beyond it is transparent and transparent (upholstered in language and flags,1989, p.394) and also means "the ability of the surface to pass the beam through it so that it shows what is behind it and can obtain transparency by mitigating whether it is color or thickness"(<http://ar.wikipedia.org/wiki>)

4- Technology: Technology can be defined as: practical application of scientific knowledge (Ghaleb Abdul Muti Al-Farijat, 2010,p. 20)

Research limits: The study is limited to:

- 1- Experimentation in the study of manual techniques and mechanisms related to the sculptural formation of acrylic ore.
- 2- Identifying the philosophical, aesthetic and technical foundations of structural sculpture.
- 3- Study the most important properties of acrylic commonly used in the field of sculpture and its association with design, compositional and technical objectives.
- 4- To identify the techniques of transparent sculpture and its potential in the implementation of acrylic sculptures with innovative properties such as the possibility of addressing the vacuum and different contact and departing from the traditional pattern of mass.
- 5- The practical application is based on the use of techniques (direct formation - drilling and removal - printing of heat transport (Decal lazerten).

6- Conducting research applications on the third level students in the technical education department of the College of Quality Education of alexandria University, numbering 160 students for the academic year 2020/ 2021.

7- Training bachelor's students in the production of sculptures in the framework of small projects.

Research methodology:

First: The theoretical framework

Below, we will review the different trends that have contributed to the use of new materials by sculptors, particularly the use of acrylic material in modern sculpture.

- **Cultural ingredients:**

Art is always associated with the cultural components of the global community, where in the 20th century there were a range of intellectual, economic, social and political factors and variables, as well as the advance of technology science.

One of the most important cultural variables that influenced the artistic thought of sculptors towards the use of the acrylic material in the formation of their sculptures is the following:

Industrial development in the development of raw materials and tools:

As an update in 20th century technology, acrylic materials have created a real difference in the modulation and rapid propagation methods that are truly different from those used in stereoscopic formation, due to the state-of-the-art and contemporary compositional unit that the material provides.

- **Artistic trends in the 20th century:**

In the 20th century, art expressed many problems related to human reality through artistic trends in the 20th century that achieved a social and environmental presence in which the relationship between the public and art changed, extending to the presence of sculptures outside museums and galleries .

- **Construction:**

The building doctrine is one of the modern artistic trends of the 20th century, where it carried the abstract features of geometric compositional by recognizing the elements of time and space through emptiness and transparency in achieving a moving rhythm between lines, blocks and sizes, and the construction has extended to the use of unlimited materials as formative means to come up with innovative artistic forms that will enrich the works of art. (Naeem Attia, 1982 A.D., p. 99), the founder of the building doctrine found the architectural artist (Naoum Jabo 1977-1990) special formative possibilities through its use of plastic ore for traditional materials and in particular the transparent ore (perspex) in the creation and installation of many stereoscopic bodies in the vacuum.

(Erika Langmuir and Norbet lynton, 2000 P. 59).Naoum Jabo has created formative relationships of lines and spaces through transparent vacuum bodies to be the main element in addition to the expressive values achieved by transparency with aesthetic dimensions of stereoscopic forms in the vacuum where the artist benefited from the compositional aspects of the plastic opacity that bear the various stresses in the implementation valuable works characterized by durability, lightness and low costs in addition to the accuracy of artistic performance. (Alex Potts, 2000, P.108.)

- **Visual vision of light in the construction school:**

The construction school was associated with light in the production of its compositions, and light became the direct means of ending the basic character of the mass and turning it into an exciting moral perception, combining time and space at work. Structural thought means in its total complex content the relationship between time and space, and it contains not static facts but renewed dynamic realities, by using the raw materials that are window or reflective of light can obtain the value of the place in a new way, and seeks to break the traditional difference between sculpture and photography, by seeking the value of space to produce structural forms of form from mere raw materials. (George Flingen, 1962, p. 75).

Sculpture at the construction school:

Structural sculpture "is a first style or an ideal form of architecture, but it aims to achieve independent functions, including cosmic or existential functions, and it is physical construction that drops the mental images of material reality to form images with a cosmic feed" (Herbert Reed, 1994, p. 82)

- **Pop Art (Public Art):**

He grew up in 1960 to portray the American consumer environment, and this art relies on assembling everything that is accessible and common in public life, especially the arts of commercial advertising, and then creating it creatively to represent the life of contemporary society(Okasha Wealth, 1990, p. 372.)

These contents therefore allowed the use of many of the expressive contents created in the field of sculpture, most of which were associated with the expression (ideology of European society). Therefore, the new materials were used, the most important of which are ready-made industrial products of plastic ore and addressed by the artist in compositional and expressive formulations to show aesthetic and compositional variables in fine arts in general and modern sculpture in particular (Hamdi Khamis, 1977, p. 62.6)

- Plastic ore:

Throughout the ages, civilization was associated with the dominant materials used by it. In the Stone Age, man used his tools and weapons made of stones, and in the Bronze Age man mixed minerals to make the bronze alloy he used in his life, and when man controlled the use of heat and extracted iron from his materials, he made iron tools and entered the iron age.

Today, in the age of plastics that control our tools, clothing, music and all aspects of life -- plastic production has increased beyond iron production in the last era of the last century, and today's global plastic production reaches nearly 200 million tons per year.(Said Al-Demardash, Cairo, p. 7.18), hand tools for wood and metal work are used when dealing with acrylic materials and are suitable for all necessary processes to form them.

- Raw Al-Akerilak :

Acrylic is one of the materials of plastic plastics with heat that has a lot of characteristics of glass, and most acrylic plastic is made up of polymer (polymethyl methacrylate) and acrylic can be formed directly using the number of tools and machines of sculpture or thermal formation or poured into sculptural molds, can be welded or glued using different labels and can be recycled and formed again without any change .

Acrylic is available industrially as:

- **Panels or strips:** transparent, semi-transparent or opaque in multiple colors and sizes used in direct modulation and thermal formation processes.
 - **Resin, granules or powder:** Resin is used in the casting processes of sculptural products, and grains or powder are used in industrial casting processes such as injections or extrusion.
 - **Acrylic filaments:** used to build sculptural product by 3D digital printer
 - **Acrylic fibers: Manufactured** fibers similar to industrial wool consisting of a long-chain industrial polymer consisting of 85% of acrylonitrile units, woven either by dry yarn or wet yarn, used in the textile and clothing industry.
 - **Acrylic colors and paints:** used in the field of painting, photography and painting.
- We must differentiate between traditional methods and the new technology used when carving acrylic as follows :
- **Traditional** methods: they basically require the use of mechanical energy to carry out various sculptures and formations.
 - **Technology developed:** The most advanced methods are using electrical, chemical or thermal power machines such as CNC machines, discharge machines or injection machines.

Acrylic ore formation technology is divided into three main methods:

- Direct formation - thermal formation - casting formation.

These methods can be implemented either using traditional manual methods or by new technology.

A- Direct acrylic formation: Depends on the formation of acrylic directly to be in solid condition using the number of tools and sculpture machines either in traditional ways or by using the means of technology developed and technology through digital control machines of various types.

b- Acrylic thermal formation: depends on heating acrylic slabs or slices first, then performing various formations by traditional methods or using the new technology methods, taking into account that the acrylic thickness used is 3:1 ml to get the best results, and when cooling the material it takes the form of the mold in all its details, and This method boils down to the artist's selection of slices of acrylic material that can soften through exposure to heat and these slides are available in a variety of areas and there are different types of transparency or darkness according to the artist's desire to present his works of art.

C- Acrylic casting: Depends on casting acrylic resin in traditional sculpture molds to obtain a copy of the sculptural work, or pour it into artificial molds in new ways such as injection machines or extrusion machines, or the acrylic is in liquid form or in the form of granules that are melted to obtain the resin needed for the formation processes. A mixture of polymer and thick liquid or crushed polymers (as acrylic polymers dissolve in the polymer) is brought in, the mixture is poured and the polymerization process is done in the molds after the addition of a strong auxiliary agent, and the casting process has helped more than any other process to advance the formation and spread of plastics, through which a large number of products have been obtained. (Abdul Majid Al-Sharif, 1999, p. 20)

- **Manual modulation methods:**

A- The formation of transparent and dark segments: The contemporary sculptor was interested in taking advantage of the plastic variations of the acrylic panels where they were formed in several different artistic ways that offer a variety of formative possibilities for the sculptor in achieving stereoscopic objects by overlapping the surfaces of the acrylic as in the works of the artist (Naoum Jabou).

B- The formation of slides by cutting, bending and installation: This method is one of the advanced methods in the plastic formulations that the sculptor has made by informing him of the plastic properties of plastic panels and their features and how to use them in the formation and formulation of his sculptures and these panels, which have been made in different sizes and the types manufactured from them can be dealt with by pieces, folding and composition in addition to softening with the heat of the ordinary flame.

- **The structural and chemical properties of acrylic:**

- **Building properties of acrylic ore:**

1- **Crystalline body:** It is an important structural characteristic that affects thermoplastic behavior, and it is impossible for a polymer to fully crystallize like metals.

2- **Moisture absorption:** Polymer absorption of moisture can be divided into two types: molecular absorption, directly dependent on polymer-forming atoms, and porous absorption, which is only visible in equal polymers.

- **Chemical properties of acrylic:**

- **Polymerization:** Polymers are formed through the chemical reaction known as polymerization, an interaction in which the longitudinal chain is built by adding monomers to each other. (Sherif Al-Sayyid Abdul Majid, 1999, p. 66)

- **Acrylic thermal properties:**

The thermally forming eating property (thermoplastic) is due to the possibility of heat-generating it to the reality of the force linking molecules where it is strong between parts of the chemical chain and consisting of chemical units (polymers) while the strength between the chains known as van Derval's strength is weak (about 100 times less), making it easier for chains to slip over each other when heating (E Driver, . Walter, 1967, p 20-22.

- **Visual properties of acrylic ore:**

These characteristics can be divided with regard to light as follows:

- 1- Transparent: Where light is carried out and can be seen through it.
- 2- Semi-transparent: Light runs out through it and cannot be seen through it.
- 3- Opaque: Where light is not carried out through the material, therefore objects cannot be seen from behind them. (L Richardson, Terry 7,13)

The visual properties relate to the molecular structure of the material such as chemical and crystalline bonds, so the electrical, thermal and photovoltaic properties of the Acrylic related to each other, the properties of gloss, sparkle, transparency, color, purity, and refraction are some of the many important photovoltaic properties of the Acrylic.

The photovoltaic properties of the acrylic can be summarized to:

1- Transparency: Is a standard for the degree of crystallization, amorphous polymers such as esterin and polymethylacrylate are very transparent, and the transparency rate of polymethylacrylate is relatively high compared to many other plastics while the transparency of many plastics ranges from transparent to opaque due to crystallization. ((E. Driver, Walter, opcit ,p 20-30.

2. Refractive coefficient: When a light beam runs out in a transparent material, one part of the light is reflected and the other part breaks (when it runs out of the material),and the refractive factor (n) depends on both the angle of fall (a) and the refraction when the light runs out in the material (r)

- **The sensory and compositional properties of the al-Alyrik opacity:** The sensory and composition properties of the al-Alakirik opacity form aesthetics on which the sculptor is based as an experience when starting to shape his work, and contribute to the clarity of his aesthetic idea.

A- The sensory properties of the acrylic muzzle: "Sensory properties are the characteristics that are aware of the five senses of man for the acrylic, where the potential in the artistic composition of sculpture is a magnet when recognizing the artistic forms and sensory properties of the acrylic and have special aesthetic qualities that distinguish it from other body materials of texture, color and smell as well as the possibility of raw The Acrylic presents a sense of the value of space as a morphological element in stereoscopic forms by formulating the sculptor for the opacity of transparency that shows the inner depth of the visual perspective, especially when the sculptor forms it to give gradients of transparency in the sculptural composition of the opacity.(Huda AnorAwad, 2002, p. 29), and through the sculptor (Naoum Jabo)'s awareness of the sensory properties of the Acrylic, he was able to express the size and density of the sculptural mass through the structural relationships he created in the vacuum, a new attempt to deal with the inner body of sculpture, taking advantage of the transparency of the sculptural composition of the muzzle form (3,4,5) In doing so, it is a far cry from previous attempts at sculptures in which sculptors were used to take advantage only of the effect of external contact with the surface of the mass or the addition of different colors and pigments to enrich the body of the stereoscopic shape.



Shape (3) Naoum Jabo, Transparent Acrylic, 1940



Shape (5) Naoum Jabo, Transparent Acrylic Brown, 1939

<https://www.google.com/search?q=nawm+gabo+sculpture&oq=nawm&aqs=chrome>).

But what the sculptor (Naoum Jabo) has done is to add new artistic entrances to deal with the material of the acrylic through the reconstruction and construction of the artistic and technical foundations of the interior spaces of the sculptural mass body where the material provided the sculptor with formative characteristics of durability and transparency more pure and aesthetic effect.

B. The synthetic properties of acrylic opacity: The synthetic properties of Acrylic ore are inseparable from their sensory properties such as the synthetic properties of the plastic and structural capacity of the ore, the qualitative weight, density and mechanical forces, which the sculptor must realize when starting to build and carry out his artistic work by dealing with the material, The al-Akelerick ore is solid as it is possible to perform and build sculptures of a large size with high bearing power with a high potential for the stability of vacuum structural shapes holograms in the vacuum. (Huda Anor Awad, 2002, p. 41)

- **Number and tools used in the direct formation of acrylic opacity:**

A- Drill 2 - Saws 3 - Files 4 - Lathes, Clicking and Frieze 5 - Cutting Tools

For good results when using machinery dealing with wood and minerals, some minor modifications are made to the tools, a series of thermal expansion of the ore, increased friction, increased heat arising and increased machine consumption, all leading to damage to the material. The most important thing to note when operating in the Acrylic is to keep the number always sharp, from the frieze knife even to the small manual drill (RJ Craw, 1981, p164).

- **Modulation methods in acrylic ore:**

There are multiple methods for the formation of acrylic ore that are used to obtain the desired effect and composition, including: 1-Hole 2- Publishing 3 - Maps 4 - Clicking and Friezing 5 - Cutting 6 - Cold 7 - Sand-Roll

1- Hole: The hand drill is suitable for drilling holes with a small diameter, for holes with a size greater than 6 cm it is necessary to use a manual automatic drill and the best results can be obtained through the use of the electronic drill and the drill made of high-speed steel and polished wide years must be selected. (Roukes, 1967,p 71,79)

2. Deployment: The type of saw used depends on the type of work to be done. The circular saw is preferred for use in straight pieces, while it is recommended to use a multi-curve saw and a sharp-shaped saw when cutting curves and small halves in the thin acrylic board or in straight pieces in the thick acrylic board and dividing the saws used into four types:

a- Hand saw: Micro-toothed saws are more suitable for dealing with acrylic material than those with large years, and a saw that contains about 18:16 years/inch is more suitable for use. (Roukes, op cit ,p 71,86

b- Striped automated saw: This saw is suitable for cutting acrylic panels, and the type for metal cutting is more suitable for acrylic cutting and those for the smallness of its years and is used in cutting curved lines with flat panels, and is preferred to be used in the deployment of acrylic panels because the long blade facilitates the process of heat stabilization, and it facilitates the cutting of complex shapes. (RJ Craw , op cit,p164,253) .

C- Swinging saws and half diagonal: usually used in large panel pieces, and can be used to make cornered or cross-cutting pieces in tight spaces.)(Roukes, op cit ,p 71,86

D- Circular saw: is the best mechanical machine for cutting straight lines and the years used should not be too wide, the ideal blade is between 5: 3 years / inch for acrylic panel thickness 3mm, 8: 10 years / 1 inch .

3. Lathes: Acrylic materials are easy to carve, but caution must be exercised to prevent acrylic from heating, carcinogens must be well carcinogenic and cooled properly and the slope angle must be between 10: 20 Drilling speeds range from high speeds of up to 6,000 rpm | minutes and high speeds are used for the rapid removal of unwanted parts in the availability of a refrigerated material, and lower maps are used for efficient finishes. High. (Ress, David, p 3-11) .

4- Clicking and frieze: Frieze machines with the edges of pieces made of ordinary metal are not the best for acrylic parts because the sticks in them are often blocked by the chips resulting from the cutting process, instead using cutters or machines with a wide range. (L Richardson, op cit,p 71.79) uses high-speed breakers taking into account the regularity of these speeds.(Roukes, op cit ,p 71,86)

5- Cutting: Plastics have low hardness coefficients as if the piece you are working on is not well reinforced, it will deviate under the pressure created from the cutting machine and this will result in equal reductions.((Jan Butler,1993,p31,239.

6- Cold: The radiator is considered one of the most important and very useful numbers in its various forms, where it softens the edges and small surfaces, the best of which are blacksmith files. (RJ Craw , op.cit ,p164,253) .

7- Sand lamination: Carefully polished surface roads by sand that are tossed at it under a certain pressure resulting in an effect like a porous surface, with very precise protrusions, and transmits light in a similar way to the entrée produced by drilling, and this technique is done with a sand-footing tool, the spaces that must remain well polished are protected. (Ress, David, op.cit, p 3-18)

- Acrylic ore assembly methods:

Many of the published acrylic plastics that have been deployed, classified and polished, or assembled together are connected by a suitable adhesive, welding, acrylic forms built or formed from a thin or heavy mass, armored panels, a combination of panels, acrylic rods or tubes, and nylon fishing thread can be used where linear effects can be given.

There are many ways in which they can be used to complete the assembly process, but the most common can be summarized as:

- Binding by paste - welding

The use of adhesives provides access to very strong bonds although it is not a suitable way for all plastic materials. Welding also results in strong linkages, but this can cause an intensification of pressure or effort in the welded arena, both of which result in permanent bonds and welds.

Light formation through acrylic ore:

Light formation aims to produce a sculpture that attracts and radiates light, whether natural or industrial, and the technology associated with light has helped to emerge what Ma'ady called free-standing photosynthesis, a sophisticated art in the 1940s and 1950s, where the light sculptures that light up and enter our world have made the sense of movement, color and design exist and are considered the material of acrylic polymers as the most common material that shows the effect of formation directly light, as it is a resin material.

(Plastic) has a transparency feature that allows the transfer of light, which adds an unusual character to the sculptural work. (A.M. Hammncher,1999, p 37.374),unlike glass, acrylic is one of the few materials that allows light to pass through the shape, where acrylic can be polished to the extent that it can reverse light. (Muhammad Zinham, 1995, p. 42)

Lighting during acrylic ore can be divided into two types:

1- Barefoot lighting: The meaning is edge light in shapes made of acrylic ore, and in fact this phenomenon is unique to the transparent acrylic material, especially transparent panels, where it can be transmitted by internal reflections towards 92% of the light inside to a polished acrylic panel to the other edge of that panel. (Ress, David ,op.cit, p 31)

2- Lighting the deep patterns: If we create inscriptions or pits on the surface of the acrylic board in one way or another, some of the light will be carried out into the air creating a kind of light glow, and we can deliberately obstruct reflective surfaces in any acrylic design that is intended to leak light out, so that the light leaks out through any pieces or pits made by the artist on the exterior of that design, and by selecting the feature of light that will leak out through any pieces or pits carried out by the artist on the exterior of that design, and by selecting the feature of the light that will We achieve it depending on the scratched surface angle with the shiny surface, the depth of the pieces or slitting and the distance from the light source.

- **Industrially colored plastic:**

Colored materials in the plastic industry consist of two sets of dyes, and the fertilizers, and can be distinguished by solubility or insoluble in the center of plastic, dyes are usually dissolved and given to the polymer dissolved in color, on the other hand the cones are subjective, and give their color to the center by spreading their molecules in it and the dyes are characterized by bright pure colors, transparent, which are less stable for light and heat than the claws.

- **Acrylic coloring methods:**

A- Acrylic dyeing in a dipping manner: The transparent acrylic board or carved shapes can be dyed either by dipping or wiping plastic by dyes at an Acetone water base and the transparent acrylic board can be painted with many non-water-based paints including acrylic cover, fennel and glossy enamel paints.

2- Acrylic coloring using polyester dough: The surface is scratched and tossed to give edges or teeth, and after wiping it with alcohol is colored polyester dough. (R. Newman, Thelma,p31 ,47)

3- Acrylic dyeing using a spray gun: The air piston with a large number of tubes from which the rat runs out is usually preferred to spray acrylic paint. (Roukes, op cit, p 71,79)

4- Printing in the field of acrylic surface enrichment:

The methods of sculptural formation have evolved and been more influenced by technology and the use of modern machines in its manufacture, which helped to develop the field of sculpture, the sculptor began to benefit from this scientific development in addition to the various artistic fields to develop his techniques and to enrich his work surfaces, including the field of printing, which was benefited from most of its images and techniques, and characterized typographic techniques on transparent surfaces with accuracy and the possibility of repeating them quality, and therefore some of these techniques are used industrially, and these techniques vary from simple such as printing using (rubber seals, and breeding, Insulation, sponges to the most complex, such as: (silk screen, decal, ink puffs) sculpture benefited from technological development and various artistic fields, to enrich the sculptural surface and printing and photographing in their different methods of application and their renewed trends played an important role in enriching the sculptural surface.

- Decal types:

There are three types of methods of producing decal paper and used in the production of any kind of images, namely traditional decal, laser-produced decal and laser dikal, all of which are applied by water slide to apply on surfaces.

first: Traditional decal: consists of a thin gelatin layer on paper and is with a bright surface and the design or image is implemented on this waxy surface and then covered with a layer of varnish (polyurethane) and in this type used colors above the paint with an oil medium to make a rich design whether multicolored, one color or even hand painted.

There are many traditional ways of printing decals:

- 1- Deep printing or photography.
- 2- Flat printing or photolithwaft.
- 3- Porous printing or skrine wire (Hend el-Badry Azaz, 2020, p. 3).

Second: Laser-printed decal paper: Laser-made decal paper is used with laser printers only and is used to produce images with dark color grades, especially those between black and dark brown, and produces images and varies relative to the content of iron oxide in ink, which varies from type of printer to another and results in a difference in the degree of lighting in the image and can be burned at different temperatures and in this way the image fuses to a plastic layer Thin above the gelatin layer on paper, so there is no need for the presence of a wax cover layer and there are sometypes of printers whose inks do not contain enough iron oxide to produce the image, including inkjet printers that deal with inks low in the content of iron oxide or lack of iron at all.

Third : Decal Lazaran paper: This method is used in the production of two different types of decal paper for surfaces that do not need to fire decal and the other for color printers that produce images full of colors or inkjet printers, which enable us to print any kind of images this multicolored image andthe burned jealousy is characterized by clarity and beauty but does not fuse with the surface layer like the rest of the decals, which makes it vulnerable to scratch and can be covered with a layer of acrylic To protect it" (Shirin Mr. Arnos, 2013 , p. 37) this type is used in the current search.

Light transmission within transparent materials:

A- The regular transmission of light within transparent objects: it is what happens to light passing through the transparent body or water and in which the light rays retain their parallelity, and the light does not cause any mutation through the transparent body, and all that happens is a refraction of light rays at the surface .

B- Dispersed movement of light within semi-transparent objects: the direction of light changes during its movement within the semi-transparent body, distributed in all directions and gives a unified sense of surface light and is said to be the full dispersion of light, and the light distribution curve in these.

Drop shadows:

This occurs when using one or more light sources, which provides us with shades or new formal and color elements, for example when using a single light source, there are places or flats in the work that do not reach the light and this condition is more positive in giving more shadow space an effect, and when using more than one light source, there are surfaces in the work that do not reach the light from a light source but reach it from another source This is less positive in the work so it is better to use a single light source to get the best shades on the sculptural piece, which in turn affects the highlighting of the spaces entering and surrounding the shape with a light contrast resulting from the lit surfaces and surfaces on which the shadows fall and this occurs as a result of the light source used.

- **Small businesses:**

It's divided into two types depending on activity and injustice.

First: Where is the activity (productive - service - commercial)

Second: Where is the partridge (small, very small, very small)

Bachelor's students have some marketing secrets:

Small projects have a high capacity, exploiting a great deal of energy, confusion, investment, multiple public opportunities, supplying the inside of some production crises, and also characterized by a decrease in the amount of money invested in them, and its potential for innovation, flexibility and requisites with the change of the fence, as well as the "investment of the heads of the funds in a small industrial project that creates the opportunities of more general investment of the most important investment in a large industrial project, and is entitled Thus, there are wide areas of generation of jobs, so that small enterprises have become a repository of new jobs, and the tool of the anti-unemployment and reduction program of non-regular uncles (Abderrahmane Naim, 2007)

Marketing expertise is complemented by all aspects of the benefit that are attributable to the high interest of the product user (the user), who studied the marketing foundations of the elvin product and the price of the product, how to promote it, distribute it, study the market, and study the nature of the decimal, These foundations are not generalized individually, but they generalized their greed, with previous secrets contributing to the generality of production realistically.

The small project is "a project that does not depend on the high technological density of a general face, professionalism is the basis in its days, the number of workers does not exceed five acres- the maximum number of its sands is from ten thousand to five 10,000 pounds- There is no financial and management in-between, and the owner of the project is the one who runs it" (Iman Mohammed Abdul Razek, 2010).

The project goes through several specific steps:

1. The stage of determining the project: this is the definition of the ideas of the project and the choice of one or more ideas between them.

2. The stage of preparing the project: This is the study of the initial feasibility of projects and the selection of the best ideas for projects that promise success.

3 . The project is evaluated before its implementation: - The financial, commercial and economic evaluation of the project is closed to estimate the implementation of the implementation, who is not, and they assess the project before its implementation. Whether national, local or foreign entities are funded for the project.

4. The implementation phase: - It includes determining the stages of implementation, strengthening them, supervising them and conducting what has been implemented, and experience has shown that if the implementation is bad; it leads to the dismantling of the project.

5. Evaluating the project after implementation: - It is included in the financial, commercial, economic, social and environmental evaluation of the project after implementation, and the evaluation is completed after implementation on the evaluation of the implementation, and for this we know the two well-being of the We are the weak or the causes of the problems that came to the project and we ignore the best of its people and take advantage of it in improving the status of the project.

Second: The application framework

The practical application on a sample of students of the third level of the Faculty of Quality Education department of technical education at Alexandria University in light of the findings of the researcher's machine during the theoretical framework of the study of research, which aims to show the philosophical and creative dimensions of contemporary sculptural formations based on the compositional and structural style of the Acrylic uncle in the geometric formulation.

The researcher in the material of Acrylic found multiple formative possibilities that correspond to the artistic ideas to which he is heading, it achieved the ease of handling the material and the lightness of weight, in addition to saving time, effort and costs during the implementation of stereoscopic artistic formations that included several characteristics combined contributed to the expression of aesthetic dimensions, This prompted the researcher to experiment and discover the possibility and properties of the raw material in a variety of ways to identify the characteristics of it, perhaps these works of art of the experiment add a knowledge aspect about the nature of the formation of the opacity and the nature of dealing with it to be a knowledge area that students can see to benefit from it because of the diversity and multiplicity of sources of formation embodied in the opacity.

Experience objectives:

The practical aspect of the research aims to achieve the following:

- 1- Finding multiple entries in the formulation of sculptures to achieve modernity and contemporary work in the work of students of the Faculty of Quality Education Department of Technical Education.
- 2- Take advantage of the value of the vacuum surrounding the work and the inner void as a formative element in the works of art carried out by The Acrylic
- 3- Take advantage of the plastic techniques of The Acrylic in achieving different and diverse bodies.

The importance of experience:

- 1- Learn about the characteristics of the contemporary sculpture of The Acrylic.
- 2- Find multiple entries in dealing with transparent compositional formulations.
- 3- To clarify the dimensions of the use of transparent materials in light of the use of structural formulations for contemporary sculptural composition works.

Limits of experience:

The researcher applies a practical experience to the students and in which the researcher deals with the results of the analytical study of the models of sculpture works based on the structural method of engineering and the theoretical framework of research in the design and implementation of a sculptural work within the classroom of the implementation of the third level students of the Faculty of Quality Education Department of Technical Education at Alexandria University and the number of students to produce a transparent sculptural work in the uncle of Acrylic The reality of the work of each student work to form a stereoscopic in the transparent Acrylic of an animal and combine the techniques of hand and machine formation and printing techniques with the techniques of decal heat transport.

Time limit of the experiment:

- The researcher designed his experiment to be applied over a month and a half in the form of a six-lesson module, six interviews, one interview per week and a four-hour period.
- The experiment in the application of the work takes four interviews, during which the production of a sculpture work with the direct formation of segments with the reality of work per student in an area of 30 cm ×30 cm.
- The experiment will take place in the first and half month of the second semester of the 2020-2021 academic year to take advantage of the accumulation of cognitive and knowledge expertise in achieving the results of the experiment.
- The experiment is conducted in the classroom dedicated to teaching the third level curriculum of the selected division as a research sample, as the place is well prepared in terms of the availability of lighting, tables and seats.

The plastic boundaries of the experiment:

- The experiment is carried out using transparent and semi-transparent Acrylic ore and dealt with using cutting, drilling and engineering direct sculpture methods as a methodical basis in the third level study.
- The experiment is carried out using various betrayals of the thickness of the available materials, which are commensurate with the idea of working with the student and dealing with them in a composition using sculptural formulations as required to implement the idea of creative work.

Setting up the place:

- The researcher conducted his experiment in a laboratory equipped with the necessary capabilities to form the material of the acrylic and can be available in the halls and factories of stereoscopic expression at the Faculty of Quality Education.

Tools used in modulation:

- The researcher used simple hand tools consisting of a hand saw to cut in a flat way to implement the desired design and a circular-shaped man to determine the spaces of the geometric circles.

- The researcher used technological tools consisting of laser cutting device and that cutting in a precise way to implement the desired design
- Blacksmith's files of different sizes to settle the stems from the cutting effect
- Sandpaper to fine-tune the work surfaces and then use the chloroform stabilizer.

Experience:

Its theme: The work of forming a transparent contemporary sculpture with the acrylic server and combining the techniques of formation and printing techniques with decal heat transport through the use of semi-transparent eating panels and slices with thickness (different) in order to achieve a simplified body of geometric overlap of a level surface and different sectors.

View the subject of the experiment:

At the beginning the researcher realizes fully that what he wants to measure and reach a mechanism is the extent to which the benefit of the philosophical and creative dimensions resulting from contemporary in the methods of formation and the use of technological media and adopt contemporary thought in the production of contemporary vacuum sculptures and hence the researcher began to present and present to the sample of the experiment that the abstract forms of animals, which are based on the method of the third level on studying and analysis and use in the work of stereoscopic formations, can be used in the same methods as plastic treatments in the work of sculptural formations The researcher intended to choose the geometric linear form as one of the elements of composition to create a kind of determinants that calls for thinking to find multiple formative solutions, and to focus the idea of switching from 3D shapes to a transparent formal body of contemporary space, then the researcher asked the sample of the experiment to do a number of sculptural maces and linear formations on the cardboard reinforced with specific engineering bodies for the subject of the experiment with a focus on the transformation between stereoscopic works and works Transparent,

the researcher based their experience in the study of sculpture in the second band in the sculpture curriculum of the Faculty of Quality Education. After the students finished the work of the maket, the researcher explained the characteristics of the acrylic aunt , and the students began the practical procedure of experimenting with acrylic opacity after the presentation and explanation provided by the researcher, but it remained an open dialogue throughout the period and time of the experiment between the students and the researcher through which they address some obstacles such as problems that meet them in the processes of practical and operational procedure of the sculptural formations vacuum .

- Apply decal to acrylic :

Decal is moved and applied to acrylic in the following steps:

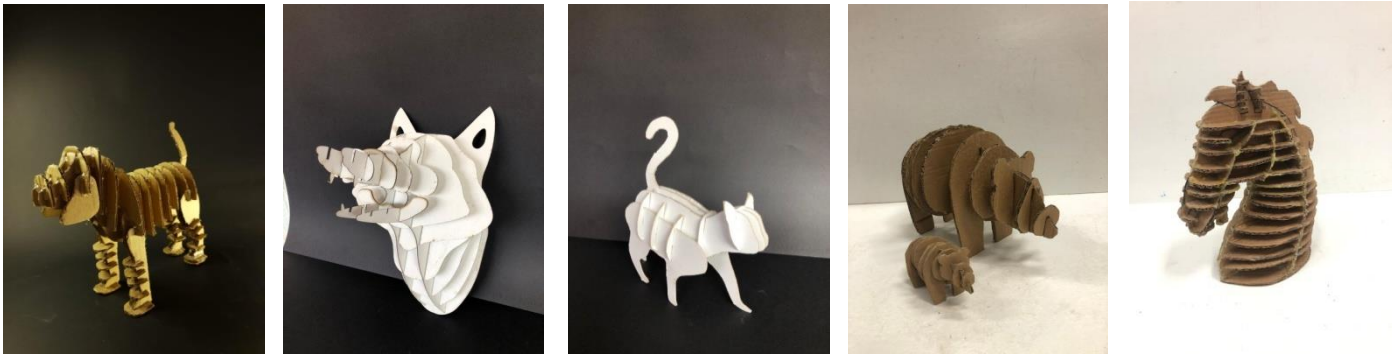
- Put the decal paper in a pot with a little warm water.
- Let the paper absorb and saturate with water for several seconds until the edition or design begins to separate from the paper.
- Lightly moisturize and wet the acrylic surface that will receive the decal edition.
- Place the decal on top of the acrylic piece by sliding it away from the paper (decal paper).
- We install the decal in the place to be decorated on the acrylic sculpture .
- Remove the water and the remaining air bubble between the decal and the surface of the sculptural body using a small piece of rubber or wet sponge by moving it from the central area of the decal towards the limbs left and right.
- Wipe and dry excess water over the sculptural body slices.
- We leave the decal to dry.

The following is a review of the most important technical experiments carried out by the same experiment in the material of the Acrylic and through these works the researcher shows the various methods of formation in addition to identifying the safety means that follow during the implementation of the experiments and what is the educational benefit of each experiment so that it can be used in the field of stereoscopic formation.

Research experience

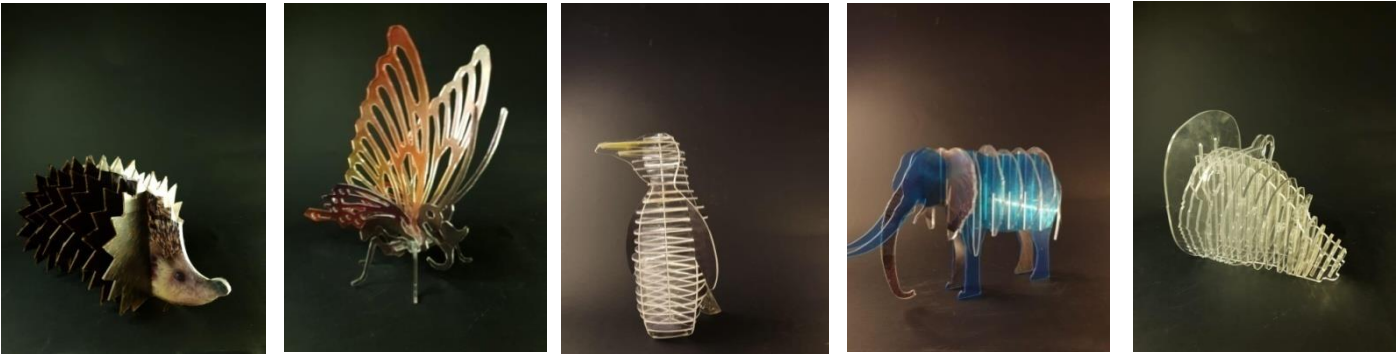
For students of the third division - Department of technical education, faculty of quality education - University of Alexandria.

Examples of some sculptures executed by cardboard "Maket" (shapes 1-5)



Models of some sculptures executed with acrylic ore (figures6 of - 20)





Results:

1- Acrylic material is characterized by light weight, hardness, resistance and moisture resistance in sculptural formations measured by traditional sculpture materials such as bronze, stones and timber.

2- Some of the plastic media used when carving acrylic can be used, such as light, color, texture and transparency.

3- Acrylic ore can be used to implement some functional and aesthetic applications using the right technology.

4- Acrylic is carved by three main methods: direct formation, thermal formation and casting formation, ranging from traditional manual methods to new technology.

5- It is clear from the research that each method of formation has its own distinct characteristics, where the diversity and multiplicity of modulation methods should be taken advantage of by each method of certain features and possibilities, but there is no optimal way to follow it in the formation process, but for each method its approach depending on the nature of the form .

6- Some types of plastic take the appearance of other materials such as (transparency of glass - sense of bronze and granite through coloring - durability and hardness of stones - light weight - ease of formation).

Recommendations:

- 1- Emphasizing the need for contemporary sculptors to be associated with all that is modern, whether in the field of raw materials technology or machine technology.
- 2- The need to train sculptors in universities, whether students or faculty members, on the new technology, which has an impact on the development of the field of sculpture.
- 3- Take care to prepare a place equipped with all the tools needed to form the Acrylic technical colleges.
- 4- Add different methods of formation of al-Alyrik materials in the curriculum of technical colleges and stereoscopic formation departments.

References: First: Arabic References: Books:

- 1- Mr. Abdel Majid Al-Sharif: "Plastics and Rubber in Our Contemporary Lives", Al-Ahram Center for Translation and Publishing, Cairo, 1999.
- 2- Dictionary: Upholstered in Language and Media, Dar Al Shorouk, Beirut, 1989.
- 3- Okasha's Wealth: "Encyclopedic cultural terminology", Egyptian International Publishing Company - Longman Cairo, Library of Lebanon, 1990.
- 4- George Flingen: " About Modern Art ", translated by Kamal Al-Mallah, Dar al-Ma'ad, Cairo, 1962.
- 5- Hamdi Khamis: "Artistic Taste" , House of Knowledge, Egypt, 1977.
- 6- Said Al-Demardash: " Plastic Technology ", Arab Book House, Cairo.
- 7- Sherif Mr. Abdul Majid: "Plastic, rubber and industrial fiber in our lives" , Al Ahram Center for Translation and Publishing, i1, 1999.
- 8- Ghaleb Abdel-Muti Al-Farijat: " An Introduction to Education Technology", Jordan, Treasures of Knowledge Publishing and Distribution House, I1, 2010.
- 9- Mohamed Ismail Omar: "Plastic Manufacturing Technology" Scientific Book House for Publishing and Distribution, Cairo, 1998.

10- Mohamed Zenham: " Glass Art Technology ", Egyptian General Book Authority, 1995.

11- Naeem Attia: " Modern Art is an attempt to understand" , Dar al-Ma'af, Cairo, 1982 .

12- Herbert Reed: "Modern Sculpture" translated by Fakhri Khalil, Dar al-Maamoun Translation and Publishing, Baghdad, 1994.

Second: Scientific messages:

13- Iman Mohammed Abdul Razek: " Expressive drawings in African primitive art as an entry point for enriching ceramic ornaments ,"Unpublished PhD thesis, Faculty of Quality Education, University of Port Said, 2010.

14- Hassan Rashid Abdul Aziz: "The use of prefabricated decoration technique (Decal) as one of the elements of development in ceramics in the arts departments of the faculties of quality education ", the first scientific conference of the Faculty of Quality Education, Mansoura University, 2006 .

15- Abdul Rahman Naeem Abdel Rahman: " Innovative compositions inspired by Palestinian folk art printed with stencils and batik to be employed in small projects," Unpublished Master's Letter, Faculty of Technical Education, Helwan University, 2007.

16- Shirin Mr. Al-Arnos: " Modern techniques in the treatment of ceramic tile surfaces" , Master's thesis, Faculty of Applied Arts, Helwan University, 2013.

17- Hend el-Badry Azaz: "The technology of ceramic printing (decal) and its testimony in the development of the skills of decoration of contemporary ceramic surfaces", as part of the 9th International Scientific Conference of the Faculty of Technical Education, 2020.

18- Huda Anwar Awad: "The plastic and expressive values of plastic plastic formation in modern sculpture and its use in artistic education ", Master's Thesis, Faculty of Technical Education, Helwan University, 2002.

Third: Foreign references:

19- Alex Potts: "The Sculptural Imagination", Press, London, 2000

- 20- A.M. Hammncher : "Modem Sculpture Tradition and Innovation" Harry N. Abrams, INC. Publishers, New York - 1999.
- 21- Erika Langmuir and Norbert Lynton : " The vale Diction an Artists", N.B.yale Nota Bere, London, 2000 .
- 22- E. Driver, Walter: "Plastics Chemistry and Technology". Van Notrand Rein bold company - New York
- 23- Jan Butler Field "The Art of the light space" ,1993
- 24- L Richardson, Terry : "Industrial Plastics; Theory and Application" Second edition - Delmar publishers inc .
- 25- Roukes, Nicholas : "Sculpture le Plastics" Watson, Guptill Pub. New York -1967
- 26- .Ress, David : "Corative Plastics " ,Published by Stadio Vist, London .
- 27- RJ Craw :” Plastics Engineering” ,Peryamon Press , 1981.
- 28- R. Newman, Thelma : "plastics as an Art form", Philadelphia by Chilton company.

Fourth: Websites:

- 29- <https://e3arabi.com>.
- 30- <http://ar.wikipedia.org/wiki>
- 31- <https://www.are.na/block/1298554>
- 32- <https://www.google.com/search?q=nawm+gabo+sculbture&oq=nawm&aqs=chrome>.