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Wire bending in 3D projects as educational way UOP. Design Students as a case study

Asst. Prof. Dr. Aida Hussein Ahmad Jokhrasha, *Department of Graphic Design/ University of Petra*
Teach. Mrs. Sanaa El- Asad , *Department of Graphic Design/ University of Petra*
Asst. Prof. Dr. Mayyadah Fahmi Hussein, *Department of Interior Design/ University of Petra*

Abstract. Unique handmade projects as an artistic process has gained in popularity to become educational tools. As such, wire – crafting was introduced as successful methodology to teach three- dimensional forming design.
This study aims to increase the creative talent, and skills of UOP design students in order to produce projects of three-dimensional wire bending models with their unique individualistic visions. also, to provide a state-of-the-art learning process in design education. by using marketable student's projects.
Our study used the experimental with the descriptive theoretical methodology, and twenty-eight students from the graphic design department with fifteen students from the interior design department were collaborated with instructors to produce creations handmade projects.
Fifteen examples were selected to define and evaluate. from all three experiments, (2014 first and second semesters in interior design and the two other experiments was in 2018 and 2019 first and second semesters in graphic design).
The physical and environmental challenges throughout the process of design using wire-bending, together with adequate material and techniques were highlighted and discussed, especially as relates to interior spaces.
Finally, this paper found that the Wire – bending handmade art crafts are very flexible, creativity tools, and successful way of using variable materials indoors and outdoors spaces and the collaborative learning activities to create such art proved enlightening to students and supervisors.

Keywords: Wire Bending, 3d projects, educational design

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INTRODUCTION

Wire-bending inscribes "a milieu of interactions between community, senses, and the moving body while designing and making with static and dynamic linear materials for concurrent expressions of each in three-dimensional space (Noel 2019b; 2019a)"9
Metal wire is a form of ore used in many different fields of manufacturing and crafts. And the metal wires are what determines the appropriate technology for forming them.
Aligned with the concepts briefly indicated above, some researchers have sought to combine culture, and craft, through wire bending designing and making, with different degrees of success. Unfortunately, wire bending practice is disappearing due to a number of factors, including the death of the older generation of craftsmen, the lack of a system for pedagogy to pass their knowledge to others, and the younger generations' lack of interest in handcrafts, along with their desire to engage with digital technologies specially with design students (Noel 2015; 2019a)11 On the other hand, difficulty using materials to produce three-dimensional models in design education. Also, the use of modern technology was discontinuing students from using manual skills, which led to a lack of creativity in designs. (Hussein, M. F. (2017).
Moreover, current research in design through a socio-technical educational lens has made possible new understandings and approaches in design, wire bending, and craft, (see, for example Brown and Duguid 2000; DiSalvo 2015; Rosner 2018; Sengers et al. 2005; Vertesi et al. 2016).

Significance Statements

The importance of this study is to:
Developing students' abilities of critical and analytical thinking and creativity and to realize the relationships and values inherent in the field of artistic expression and to emphasize the effective role in

society according to the standards of artistic and aesthetic appreciation. the employment of metal wires in artistic formations that do not simulate nature as much as it is achieved and expresses the achievement of contrast and compatibility.
Shedding light on an important aspect of innovation and creativity in artistic works through metal wire forming or the creation of a contemporary artworks that enrich the student's artwork. And access to various forms and formations derived from expressive forms, which can be used and employed in building artistic wires made of metal wires.

Objective
The purpose of this study is:

- To investigate how the 3d students' projects might restore traditional craftsmanship – technical knowledge (principles of design) and technical manual skill (praxis) – in the dying practice of wire-bending which is a set of abstractions describing knowledge in the craft so that it can be used in design education and practice.
- To increase the creative talent, and skills of UOP design students in order to produce projects of three-dimensional wire bending models with their unique individualistic visions.
- To provide a state-of-the-art learning process in design education. by using marketable student's projects.
- To Apply the fundamentals of design, forms, space and orders with relationships in create 3d wire models in design.

Literature review
Crafting as Inquiry into Computation Exploring wire-bending in traditional practice and design education (2016)
This paper aims to introduce the three novel approaches: Digital Crafting, Computational Crafting, and Crafting Fabrication. The findings of this paper have indicated that wire-bending is an effective tool to be used in teaching younger generations design and traditional skills. V. A. (2016)
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Design Computation and Restoring Craftsmanship: The Bailey-Derek Grammar in Wire-Bending (2019)
This paper discusses the restoration of craftsmanship in the practice of wire-bending through assessing a computational design tool. The methodology in this paper included analyzing document and artificial analysis, conducting workshops, and repairing the craft. The outcomes of this paper have shown how wire-bending partakes in redeveloping technical knowledge and skill in a craft. Findings also implicate using design tools aids in promoting the craft by generating new forms of practice, and roles for contribution and involvement. (Noel, V. (2019).

Computational Design and Fabrication of 3D Wire Bending Art (2019)
This study proposes manually creating 3D wire-bending art from given 3D models by a computer-assisted framework. The framework used allows users to manually fabricate 3D wire bending art effortlessly and efficiently, as it extracts a set of 3D contour-curves from various viewpoints as a target design of wire sculpturing. Wang, Y., Yang, X., Fukusato, T., & Igarashi, T. (2019)

Image-based reconstruction of wire art (2017)
Metal sculpting, wire jewelry and furniture design are all objects created by wire-bending. To create such objects, this paper introduces an innovative technique in reconstructing a set of continuous 3D wires with each wire being composed of an ordered set of 3D curve segments.
Liu, L., Ceylan, D., Lin, C., Wang, W., & Mitra, N. J. (2017).

Methodology
Our study used the experimental with the descriptive theoretical methodology, and twenty-eight students from the graphic design department with fifteen students from the interior design department were collaborated with instructors to produce creations handmade projects.
fourteen examples were selected to define and evaluate. 10 projects from the two experiments of graphic design and 4 projects from interior design experiment.

from all three experiments, (2014 first and second semesters in interior design and the two other experiments was in 2018 and 2019 first and second semesters in graphic design).

Describe the Experiments

The physical and environmental challenges throughout the process of design using wire-bending, together with adequate material and techniques were highlighted and discussed, especially as relates to interior spaces.

Our method exploits two main observations for these three experiments: simplicity - wire objects are often created using only a small number of wires, and smoothness - each wire is primarily smoothly bent with sharp features appearing only at joints or isolated points.

project requirements

To design a metal wire project, students are required to choose the type of element or design to be implemented. The designs of the students were varied, such as choosing a type of animal or bird, abstract shapes, or models of the human figure or form in abstract flowing shapes or from the inspiration of the student's imagination with his freedom in the choice of technical quality that will serve the design to be implemented. as follows:

- All of the student select his one concept from external shapes by using sketch lines. after that the students developed their concept with supervisors by using important basic features in it while neglecting the fine details.
- After selecting the shape to be worked with, the type and style of formation, such as braiding, melodic or braiding were chosen.
- Thinking about the basic principles and design principles such as balance, rhythm and movement were the basic requirements of this project.

How to transfer the real shape to an abstract

Two ways for implemented the concept were chosen in these experiments, Either the pictures are drawn directly from nature, or they are photographed with a camera and then abstracted into simple lines and neglecting the fine details, such as stripping the tree of its leaves and keeping the branches.

After determining the shape to be worked with, the type and style of formation, such as overlapping, interlocking and interlacing with rhythm unity and movements were chosen.

Participants

Human Participants

There are two types of participants in these three experiments. the first experiment was in department of interior design in the second semester, basic design 2 (202102) 2014 course with 18 students.

27 students were participated in the Graphic Design Department (203223) for two semesters: course (203223) Graphic Design Techniques, Content & Tool (Second Year) 2018-2019. The ages of all students were from [18-20].

The projects in these three experiments were directed by three instructors, three teaching assistant and members of the jury, divided into internal jury's (faculty members) and two external juries' (graphic and interior) designers for the labor market).

Instrument participants:

In the three experiments in 2014, 2018-2019 the students used the following:

- Three classrooms for realistic courses with reasonable working conditions.
- 45 white drawing boards with 45 movable chairs were used in all four classes with a white writing board and one desk with two chairs for teachers in each of the three classes.
- Data monitor and screen were used to illustrate various examples of wire bending projects in all experiments
- Different thicknesses and colors of wires, were used.
- Nails with different colors of beads and wool yarns used for hold the projects in the base.

- Pliers repair tool and Cut wire cutters were used with Special paws.
- Different colors of Canson papers, hardboard papers and pencil were used.
- metal clothes hanger was reused and clips papers to help students for creating a bended wire projects.

Data collection

Data were obtained from books, papers, and websites of scientific journals and the final results of assessments by internal and external jury members of the two studies in three courses in the two departments we mentioned earlier.

The target demographic in this research was interior & graphic design students, educators and interior designers from the labor market.

The collection of research samples was based on the top fourteenth projects with high evaluations from all years and departments, eleven projects were selected from graphic design department, while, three projects from interior design department.

The data was collected and analyzed to assess the relationship between innovation and the benefits of new wire bending projects.

The researchers have been careful that the data obtained from members of the jury is not 100% correct. We demonstrate our method on a wide set of real examples with varying complexity and present high-fidelity results using wire bendig with many different materials like natural stone, wood, hardboard paper and color papers

The results of student's project in first semester, Graphic Design Techniques, for Metal Wire, Material & Tool (Second Year) 2018-2019

Description, analysis and desiccations of students wire bending projects
Graphic Design /First project in first semester 2018,2019/Wire bending product.

Project (1) Tanoura.

The human element was used to represent the traditional Tanoura dancer by reconfiguring the wires to obtain continuous movement, balance and rhythm across to emphasize the profession and its sustainability generations.

paper clips were used in forming the clothes of Tanoura, while the wire bending methods were used to create the human body silver colored was used in this project. see pic (1).

Project (2) Wedding dress

Coiling wire art was used to create the wedding dress in many scales, unites, Rhythm and reptation ways. Also, the interlocking with overlapping between these unites was used to joined them.

Wire bending with silver colored was used to create the projects. See pic (2).

Project (3) Dancers

more than one method was used for wires bending for hair and bod, space forming of the two ballets dancers were treated with rhythm, balance and movement. See pic (3).

Wire bending with silver colored was used to create the projects. See pic (3) Dancers

Project (4) Mother and son dancing

Three basic elements with different sizes for the girl, child and ball were used in this project projects silver and bronze metal wires bending were used to focal point the viewer's attention to the various design elements like centralized rhythm and movements of mother dancer skirt, with a different scale between the two objects.

A cross section of a real tree trunk was used as a basic element in this project. therefore, these two different materials (natural wood, wire bending art) were achieving a successful contrast with unity compositions. See pic (4)

Nails were used to anchor the two main project elements (wood and wire bending).

Project (5) Tanoura Sufi Dancer
The project was derived from a poem by one of the Sufi poets, dubbed (Ibn al-Farid), for forming a Sufi figure from wire and employing it in a poster, with a section of this poetry.
Several sizes of silver-colored metal wire were used to form the body of the Sufi man A hat was created by using black color as an approved imitation of Sufism. See pic (5)
Metal wire was used in several sizes, thin and thick, in the project, in black and silver colors and paper for printing the poster. See pic (6)

pic (1) Tanoura

pic (2) wedding dress

pic (3) Dancers

) Tanoura sufi 5pic (Dancer
pic (6) poster of the sufi dancer
pic (4) mother and son dancing

Project (6) The ant (Dole)
A new abstraction figure for the ant (Dole) was formed by the metal wire in a spiral form to create balance antenna with the balance hind legs. Also, Strings of wool colored green were incorporated into the head with thorax, abdomen. while the feet were created from blue wool.
The character of (Dole) ants was used in a propaganda film advertising poster. See pic (8)
Two white colored beads were used،and metal wire, Also, strings of wool and used paper for printing the poster. See pic (7)

Project (7) Abstract curvy tree
Handmade wire bending abstract tree wire bending handmade abstract tree was created by using many different principles of design rhythm with different scale and proportions were used to design a tree leaves, while the bending wires and it's twisting were creating balance space in this project.
Metal clothes hanger was reused to help students for creating a bended wire project. See pic (9) handmade wire bending abstract tree.

Project (8) Abstract tree
Design the tree was depended on the Abstraction with simple elements and linking it through the use of

irregular stone from the Jordanian nature, to create a kind of harmony through different materials. Tree trunk was linked to ensure the balance with stability of the project. See pic (10) An irregular stone from nature and silver-colored metal wire bending was used.



pic (7) The poster of Ant doll
pic (8) Ant doll curvy tree
pic (9) Abstract
pic (10) Abstract tree

1.1 Graphic Design /First project in Second semester 2018,2019/Wire bending product, With light and shadow

Project (9) Dream in freedom
Thinking tool: The objective of this project is the shape, its shadow and the effect of the shadow on the design idea of the shape. Trying to dismantle the restrictions
The figure in this 3d composition tried to broke down the restrictions, but was still tied to it dreams of gaining freedom.
The figure was designed with a smooth flow and flexibility in movement and rhythm in the composition gave a kind of imbalance and unstable movement. see pic (11)
In this form see pic (12) the shadow gave a kind of balance and imaginary stability, contrary to reality

Nails were used to hold the shape and using coiling twisted silver wires around the natural wooden base.
Project (10) Gymnastics dancer
The perfect balance of the gymnast while trying to jump over the ball gave a state of movement. Wings were added to the character in a balanced and imaginative way.
Shadows was used to exaggerate the shape. See pic (13)
Two colors of wire were used, the first was the gold wire, the twisting and interlocking method was used, while the silver wire was used to bend the wires and create the body, legs and ball. See The shadow of Gymnastics dancer pic (14)
Project (11) The mask
The mask was created by using one type of the Wire bending, while the balance and unity were used for creating the eyes and gives the continuous and positive vision in space See pic (15). as well as Shadows was used to gives the mask some of mystery and abstraction. See pic (16).
Two colors were used, the first was the silver wire used to create the mask face, while the natural wood was used to create the base, Nails were used to hold the mask on the wooden base.




pic (11) Dream in freedom
pic (12) The shadow of dream in freedom

pic (13) Gymnastics dancer
pic (14) The shadow of Gymnastics dancer

pic (16) The shadow of mask

1.2 Interior Design /First project in Second semester 2014/Wire bending product Project (12) The envy blue eye
The blue eye was utilized as a symbolic sign of envy also repetition, rhythm and movement were used as elements in the forming of the overall shape and Achieving The blue eye was utilized as a symbolic sign of envy also repetition, rhythm and movement were used as elements in the forming of the overall shape and Achieving. See pic (17)
Silicone glue gun was used to hold the silver wire shapes and the blue bead was used to create the envy eye. See the back of the envy blue eye. pic (18)
Project (13) Mann pulling life wheel
The man pulling the heavy cart is an indication of the search for livelihood. The man reflects the increasing demands of life and weight like a wheel spin.
project is stable on the ground and appears harmony and harmony through the intertwining and merging of colored metal wires with each other, Also, the reptation was used in the wheel. See pic (19). A set of colored metal wire and a base of thick brown cardboard were used in this project.
Project (14) Art& Technology The human brain
The project reflects the human brain, which consists of two parts, technology and art, Colors were employed in the spiral form to represent the art side of the brain, while metal wires cube were used to represent technology movement, repetition with rhythm were used in the two figures wile. See pic (20). Rainbow colors were used to design the art side, while metallic wire was used to design the technology side.
The shapes were hold using a silicon finger gun on a black hardboard carton

pic (17) Front view of The envy blue eye
pic (18) Back view of pulling life wheel
pic (19) Man

pic (20) Art &

Results;

The results shed light on how the ideal usage of wire bending design aids in restoring technical knowledge and skill in a traditional craft.

Results also indicate that the final projects of students creating new forms of practice, and new roles for participation and engagement with Jordanian community.

Conclusions

1. Sustain the folklore by using wire bending methods in teaching.

3. The best ideas of folklore to produce gifts to stimulate tourism in Jordan are Forming wire bending handmade student's projects.

5. Wire cutters and wire bending tool are the best tools that can be used to cut and bend wires to create the students design projects.

6. Utilizing the fundamentals of design, forms, space and orders with relationships to create abstract models that have been used in design education.

7. Wire bending is one of the best and easiest ways to teach three-dimensional formation, especially in design courses such as (techniques, materials, digital media, and the basics of three- dimensional design).

8. Objects created by connecting and bending wires are common in furniture design, metal sculpting, wire jewelry, etc.,

Recommendations

- The possibility of students' participation in teaching people with special needs the profession of bending wires to preserve the Jordanian folklore.
- The possibility of exploiting and replicating the experience in teaching students of similar specializations, such as architecture, sculpture, ceramics and industrial design.
- Teaching handicrafts to students as a future profession in the service of the local Jordanian community.
- The possibility of employing sculptural manufactured in the external environment with different sizes by the inspiration of wire bending student's projects.
- Metal wire is a one of the easiest ways used in many different fields of manufacturing and crafts.

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