

منهجية فعالة لصقل مهارات الطلاب في بناء النماذج الأولية Prototyping باستخدام تقنيات النمذجة المتقدمة في التصميم الصناعي

An effective methodology for honing students' skills in building prototypes using modern modeling techniques in industrial design

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Abstract:

The (importance) of the research for students of industrial and product design is to realize a new effective methodology that improves the teaching of Prototyping through a case study and the application of that methodology to students of the Industrial Design Department at Helwan University, students of the Product Design Department at 6th of October University, and students of the Product Design Department at Badr University in Cairo and they achieved distinctive results that had not existed before.

The (research objectives) are also represented in arriving at an effective methodology to hone students' skills in prototyping for students of advanced teams in the specialty of industrial design and product design, training students to use the proposed methodology in the physical display of product models, and providing students with the ability to simulate the physical characteristics of the final product to be an almost real test sample of the product.

The research claims that the proposed methodology for teaching the subject Prototyping will improve, develop, and raise the level of students and make them able to simulate the physical properties of the final product with high accuracy and professionalism.

The most important (results) were that students gained the ability to simulate the physical properties of products, an almost real simulation of shape, color, texture, masses, sizes, weight, and also use them to be a semi-real test sample of the product, arriving at an effective methodology that improves the teaching of the subject of "modeling" or what is called Modeling, and Simulation or "Initial Model and Sample Design," which is the title of this course in different universities.

As for the research recommendations: The researcher recommends continuing to improve the teaching of the "Prototypes" subject, introducing students firsthand to digital modeling machines, and the conditions for connecting the 3D model to them so that they can operate it without problems.

As for the guiding words, they are "Methodology" - "Prototyping" - "Advanced prototyping" - "Industrial design".

The phenomenon that is the subject of the research:

Prototyping is one of the most important stages of designing any product, and it is considered an essential stage before the product appears on the market. The industrial designer must have full knowledge and awareness of that stage, and must acquire skill in it whether he is a student,

graduate, practitioner, or freelance designer, and this research is primarily concerned with students, especially advanced stage students in the field of industrial design and product design. It is noticeable that the level and skill of students are weak in those important subjects for the specialization, and it was necessary to come up with a practical, applied, effective and successful methodology that reaches the level of students to a high degree of accuracy and skill in simulating the product, whether simulating in shape, color, texture, size or use of it. This subject or course is of utmost importance in the specialty of industrial design and product design.

Research Problem:

The problem is that students need a new methodology. This proposed methodology for teaching the subject of building prototypes, Prototyping, which has another name in some universities, (Modeling and simulation prototyping) for students of advanced teams, will improve the method of teaching that subject and develop the students' experiences, both in computer modeling programs and learning about modern modeling machines, which leads to the emergence of excellent results that fulfill the desired purpose, which is to bring the prototypes to an exact simulation of the product, and the researcher in this research must prove it in practice.

Research Assumption:

The research claims that the proposed methodology for teaching Prototyping will improve, develop, and raise the level of students and make them able to simulate the physical properties of the final product with high accuracy and professionalism.

Importance of the study:

- 1- The importance of students' skill in prototyping, especially students of advanced teams, and improving their level.
- 2- Giving students the ability to simulate products almost realistically, whether in shape, color, texture, size, weight, or use.
- 3- Finding a new effective methodology that improves the teaching of Prototyping through a case study and applying that methodology to the students of the Industrial Design Department at Helwan University, the students of the Product Design Department at 6th of October University, and the students of the Product Design Department at Badr University in Cairo, and achieving distinctive results that were not present before.

Research Objective:

- 1- Arriving at an effective methodology for the Prototyping course for students of advanced teams in the industrial design and product design majors.
- 2- Training students to use the proposed methodology in the physical display of product models (case study).
- 3- Giving students the ability to simulate the physical characteristics (shape, color, texture, and size) of the final product to be an almost real test sample of the product.

4- Improving the teaching of this subject in the specialization of industrial design and product design.

Research Methodology:

The research is based on the experimental and analytical method.

Research plan:

To prove the claim, you must follow a plan to reach the goal:

A person thinks when he faces a problem, if some information related to the problem is available, the thinker relies on this information, and may ask for more of it to reach the unknown elements in the problem. We express this in the language of logic by saying: The thinker moves from the premises to the results, and this is Inference. Inference, in its general sense, is the mental process through which the transition is made from the unknown to the known. In the beginning, one must know the meaning of the word methodology and what is the benefit of using it to accomplish something... There are several axes of the research, which are:

- 1- The meaning of the word “methodology” and its usefulness.
- 2- History of model making, why they are made, types of models.
- 3- Advanced modeling methods and means (used by students).
- 4- Explaining in detail the methodology proposed by the researcher, and its results after applying it.
- 5- Results “Analysis and interpretation of results” “How students benefit from the methodology”.
 - (a) Raising students’ skills in how to obtain the dimensions of a product through “reverse engineering”, where the student relies on a picture of the product while knowing the exact model of the product. There are websites that support this, and teaching the student how to accurately raise the measurements of a product in front of him/her, and how to build the measurements of a product on the basis of some of its parts whose dimensions are standard. For example, it is possible to reach the dimensions of a coffee machine if the dimensions of the cup or cup of coffee used are reached. For a car, for example, its dimensions and measurements depend on a basic thing whose dimensions are known, which is the human body.
 - (b) Raising the students’ skills and level in using different and varied materials such as foam, all kinds of wood, and all kinds of acrylic, and thus the student learns about the methods of forming and operating these materials and the methods of assembling them and gluing them together.
 - (c) Refine students’ skills in how to finish any surface, whether it is wooden, metal, plastic, etc., as each has its own characteristics and each has its own method of finishing.
 - (d) Providing students with the ability to simulate the physical properties of products, an almost real simulation of shape, color, texture, masses, sizes, weight, and also to be used as a near-real test sample of the product.
 - (e) Arriving at an effective methodology that improves the teaching of the subject “Models” or what is called “Modeling and Simulation” or “Design of Initial Models and Samples,” which is the name of that course in various universities for students of advanced teams in the specialty

of industrial design and product design, through three different case studies from Three universities that achieved excellent results.

(f) Providing students with the skill in dealing with simulation programs on the computer, because these programs are the ones that deal with digital machines.

Stages of the methodology proposed and applied to students by the researcher

The first stage (choosing the product):

Each student chooses an image of a specific product, and the choice is made according to:

■ Category of use:

It means whether the product is in the category of general use or private use. For example, the products that are found inside the home are in the category of private use (blender - mixer - alarm clock - iron - television - hairdryer... etc.), while products for general use are represented in (plane - bus - ship) etc.). The student must first determine the category of the product, whether general or specific.

■ Product size:

There are products for which it is possible to prototype the same size, i.e. Scale 1:1, such as household products, and many of this type fall under the category of special use products, while general use products such as airplanes, cars, missiles, and ships must be reduced in size to a suitable scale.

■ Product model:

The word style here does not mean the technical school, but rather it means whether the product is a classic product design or a product that follows modern lines in design, as shown (Figure 9).

Practical application of the product selection stage with students from the University of (6th of October, Badr, Helwan):

The products that were chosen by the students of 6th October University are “an Airbus A320 plane and a Limburghini Aventador” (Figure 10). The products that were chosen by Badr University students are “a mixer, a coffee maker” as shown in (Figure 11). The products chosen by Helwan University students are a space shuttle and a hair straightening iron, as shown in Figure

The second stage (reverse engineering) to arrive at the product dimensions:

One of the most important stages in the methodology is the reverse engineering stage to obtain the dimensions of the product as a whole firstly, then an engineering drawing of the product to obtain the dimensions of the details secondly. What is the method that enables a student to obtain the dimensions of a product using only an image? To solve this problem, there are two steps:

The first step (obtaining the “general” product dimensions):

1- Google website, when you log in and write Coffee machine dimensions, we will get the dimensions of general coffee machines, length, width, and height. If we want the dimensions of a car or any product, we follow the same method, whether the goal is to obtain general coffee

machine dimensions, or by writing the model of the machine or product, we will get the general dimensions for that specific category. For example, to obtain the dimensions of the Airbus A320 aircraft, we write the model in the search and the following is produced (Figure 13), taking into account that the dimensions can be in inches, feet, meters, centimeters, or millimeters.

2- Search on Google for blueprints, then write the exact name or model of the product in the search, and next to it is the word Blueprint, which means a plan or diagram of the product. For example, we write Airbus a320 blueprint and we will get the same results as before.

3- Finding the real product, if available, and raising its dimensions accurately or carefully.

5- Recommendations:

The researcher recommends continuing to improve the teaching of the “prototyping” subject because it is an integral part of the process of designing any product.

- Introducing students firsthand to digital modeling machines, how to use them, and the conditions for connecting the 3D model to them so that they can operate them without problems.
- Teaching students the important programs on the computer for 3D modeling because they are important for clarifying and displaying the design and important for making models as well.
- Teaching students how to accurately simulate a product so that it appears almost real and pay attention to the smallest details in the product because these details are what shaped the nature of the product.

6- References:

First: Arabic references:

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