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Model-Making and Its Practices Improve Design Process for Beginners Students of Architecture &Product Design

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Abstract

The present paper has explained how the physical and CAD models could be useful in design projects for students studying degrees in architecture and product design. When it comes to a systematic design process, detailing and materialization and model-making steps are frequently ignored in design education. Detailing and materialization and modelmaking considerations are frequently disregarded in design education after something has undergone a careful design process. In order to create the appearance of completeness for potential clients, teachers typically instruct their students to concentrate on recognizing problems, coming up with creative design solutions, and conveying "nearly accomplished ideas" in the form of detailed and sophisticated depictions. This study also discusses the methodical approach to teaching design and practice in terms of choosing the finest models and prototypes. Students discovered that rather than models of the actual building, the findings of a survey, or the final design, both physical and CAD modeling environments have the ability to produce models for architecture. The authors also advocate keeping a strict approach to conceptual and imaginative development as well as a targeted cognitive approach through Model Making for researching design themes and then formulating solutions.

Keywords: Physical Modelmaking, CAD Modelmaking, Design Process

1 Introduction

In the most general sense, model-making making led to the practice being properly operational and easy to understand. The model may be viewed as a lens using which actuality is understood and represented by deliberately decreasing complexity, focusing on particular parts, adjusting scale, adding coloration, etc. A model can serve as an exploration tool, allowing for the posing of new queries, the formulation of hypotheses, and the investigation of potential answers. Models are a depiction of ideas, concepts, and realities that are
inextricably linked to their application. In this essay, the term "model" refers to both this method of representation and the principles it stands for.
In a variety of areas of human endeavor, the concept of the model—a mental construction with a system of representations—is present. In a scientific study, a model is deemed sound if it can be replicated under controlled conditions, regardless of the researcher. Models may be used as the foundation for conceptualising, conveying, evaluating, and achieving the design aims in design. Design by definition works with the novel and the non-existent. The terms "models of" and "models for" are used by Ranulph Glanville to describe this distinction (Cannaerts, C. 2009). Whereas design is involved with creating models for an ideal (better) world, scientific research creates models and knowledge about the world. Design is more interested in the globe and how it could be, whereas science is more concerned with the world like it is. Glanville continues by arguing that computer-aided modeling is unable to successfully create models for architecture since it is confined to creating models of architecture. While models might be considered explorative, models might qualify for classification as interpretive. This study explores the question of how much physical and digital modeling approaches may serve as models for architecture by applying them to the routine practice of model building in architecture. Do the mediation processes for physical and digital models differ? Does a design approach that combines the physical with the digital modelling in a combination form advantage it?

2. How important is the physical model?

Dunn claims in the publication of "Architectural Modelmaking" which "various sorts of models were used widely to explain gaps in knowledge across history" (Dunn, N. 2014). This is due to the fact that models may be extremely provocative and stimulate simple comprehension as a communication tool. Models represent a potentially valuable source of information since they offer a variety of three-dimensional characteristics that are taken from the "real" environment, such as size, shape, colour, and texture. Although the model's "language" remains so rich, every nuance of information may be encoded in a smaller amount of space, which reduces the amount of time it takes to decode, according to Dunn (Dunn, N. 2007). essentially having an attempt to visualize it, the model enables us to interact with 3D. This not only makes it possible to communicate with the receiver (like their faculty) more successfully, but it additionally allows the one who transmits (like the student) to grow and improve its functionality. It is the most effective approach to convey a concept to others. According to Voulgarelis and Morkel (2010), "the models assist in physically maintain the design notion in conceptual progress." The model provides the greatest 3D representation of the initial idea when compared with different graphic formats. It is simple to obtain and convenient to refer to again. The importance of a model, according to Rolf Janke in his classic Architectural Models, "is situated not solely in (the architect's) ability to express in plastic in terms the finished result of his discussions, but in providing him with the means -- throughout the design procedure of physically observing and, consequently, managing spatial problems" (Voulgarelis, H., & Morkel, J. 2010). Most designers and scholars discuss how constructing models helps them develop their design ideas. During assessments, they claim that using models for a design tool is crucial.

2.1 Model-Making Stages

Model-making stages are divided into four major parts shown in the figure. no.1 - a) Trial model b) Mockups c) Detailed Model d) Prototype. In the initial stage, one should first work on a trial model (for the development of random forms/surfaces and mock-ups). And, in the final stage, the prototypes are prepared for testing of the product and its functional (or behavioral) aspects. Figure no. 1 elaborates on various stages in the model making.

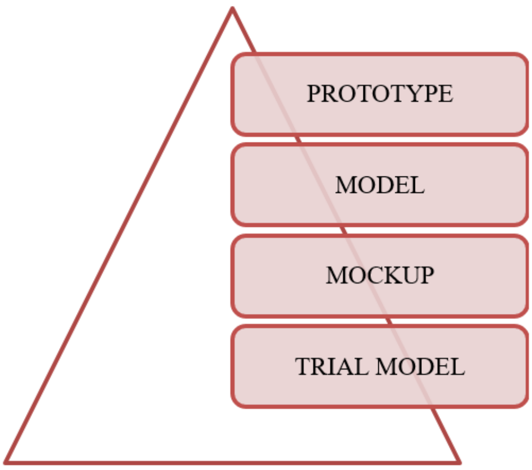

Figure. no. 1 Model making Stages

2.2 Model-Making Process

There are several vital processes involved in the model making. Following Figure no.2 summaries model making processes:

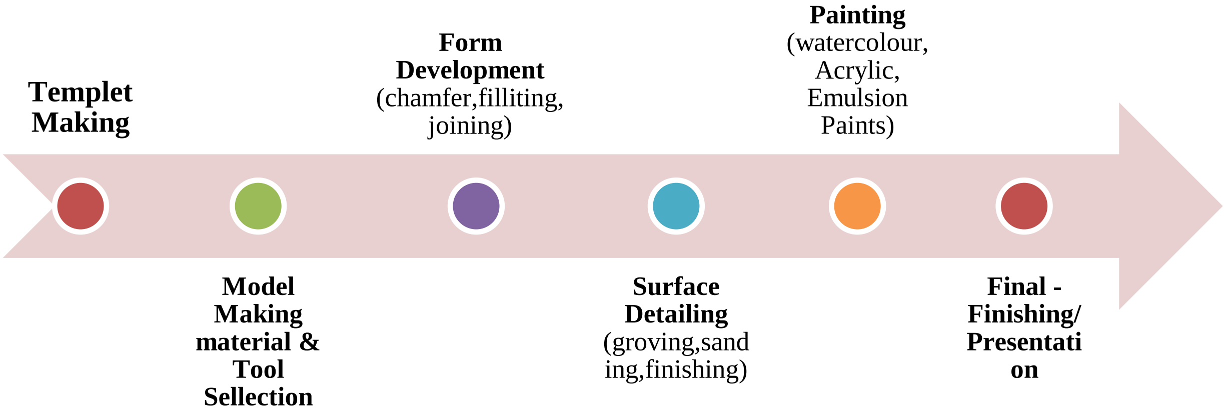

Figure. no. 2 Model making Process

2.3 Model-Making Tools And Equipment used in the experiments

All model-making tools such as cutting tools, measuring tools, finishing tools, and so on, are useful in developing hand-eye coordination which is an important requirement for inducing creative skill. While carrying out experiments with students of architecture and product design, students were observed when they used these different tools. Student's hand-eye coordination was also noted. Cutters, loppers, saws, and similar tools are used to shorten larger pieces of selected model-making material. These cutting tools helped students to compare larger pieces with smaller ones and subsequently, develop the experience of using smaller pieces of selected model-making material against larger pieces of selected model-making material. Students were also provided with both manual tools and power tools. These tools were supplied to students to observe whether any problem-solving skills are triggered in students or not. And, to understand how creative skills are developed by using these manual tools and power tools. When students were using measuring tools (while they were doing some given tasks in the studio) such as scale, tape, caliber, and so on, students were observed particularly solving some mathematical or measuring tasks (such as the thickness of the selected model-making material, and so forth). Thus, the use of measuring tools was meant to observe mathematical problem-solving skills an important objective of the creative skill development stage of the experiment. How different minds of the students (architecture students, product design students, graduate students, and post-graduate students) solved the given tasks or problems in different ways. Sometimes few students often used similar tools repeatedly namely, hammers, grinders, and so on. And, when such students were asked to avoid using tools like hammers, grinders, and so on, then the results were observed, and found that they came up with a unique form of the product which was never observed before by that student. This experiment might have helped in developing the imagination and creation skills of that student.

3. Experimental Setup

3.1 Participants Selection

80 people participated in this study. case studies and experiments – of architecture and product design students All participants were chosen at random and were not informed of their assignments. In simple terms, they were chosen because it would be difficult for them to encourage spontaneity throughout the experiment.

3.2 Group Selection

The participants were divided into two groups (A and B) using different tools in each task of early ideation and idea development task. Group A used Physical Model making in the early idea generation and idea development tasks given, whereas Group B was allowed to use CAD Model making in any tasks and continued with digital software in the further development of the idea. Each group consists of 40 participants randomly.

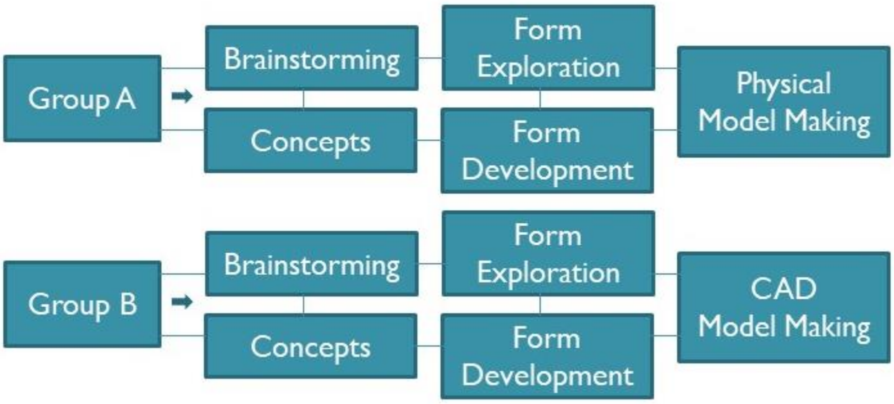

Figure. No.3 The Process During Experiments

3.3. The Design Process:

Designers and other creative professionals utilize the design process, which is a methodical and iterative procedure, to solve issues, build new products, produce visual content, and make experiences. It involves a number of phases and activities that aid in converting concepts into workable solutions. Although there may be changes depending on the design discipline, the following phases are often included in the overall design process:

3.3.1 Preliminary steps

Initial information concerning the participants had been collected during these introductory and briefing sessions. The teachers orally provided the guidelines for performing the activities as well as the design project brief. Each participant received a set of materials and was informed that they may obtain more supplies and tools if necessary. The participants/students in the preceding stage were allocated into two groups of 40 students each at random. The subsequent exercises entailed creating a stool that was able to transform into a variety of different shapes and functions.

3.3.2 Brainstorming and Concept/Ideation Development
At this point in the process, each participant completed the job of brainstorming a variety of early ideas/concepts for Group A and Group B.

3.3.3. Form Exploration and Design Development
Participants used an innovative form of exploration in the design project to build on the early concepts given in the previous stage. During this phase, Group A was assigned to utilise physical models, while Group B continued with the design process using CAD modeling/digital software. Both groups explored the form and design development of their design projects

3.3.4. Physical model making and CAD modelmaking
At this time, each member accomplished the allotted job, which included developing a comprehensive design project from conceptual thoughts through physical model construction for Group A and CAD model creation/digital software for Group B.

3.3.5. Face-face Interview and Questioner
An individual interview involving each participant was done after the design development of the project to review the process. They were asked to share their thoughts on what they experienced during the design process by the facilitators. Participants were specifically asked to consider the procedures that improved their capacity for critical analysis and creative expression.

3.3.6. Definition of Problem And Trends (Group A & Group B)
Design Brief:
Design a Chair for Youth - Inspire from Nature.
Introduction: A chair, especially for one person, usually has four legs for support and a rest for the back and often has rests for the arms. The material will be weatherproof and able to withstand both summer and winter climates. It should be as safe as possible with all the mechanisms being simple to operate. It will be possible to manufacture the furniture in either 'one off' or 'batch production'. Costs will be kept to a minimum. The chair should be stable.
Stages:
Ergonomics &User Studies
Market survey & Product case study
Preliminary sketches for the design of the product selected
The final design of the product selected
Work on the model of the designed product.
Requirements: A3 sheets + Scale Model and CAD model
1.Brainstorming
2.Concept/ Ideation
3.Form exploration
4.Design Development
5. Physical Model (Group – A)
6. CAD model (Group – B)

3.3.7. Experiment: Design Project- Model Making Survey (Group A & Group B)
Group A- Physical Model Making:
Students/Participants had completed their design project through physical model making as shown below figures: 4

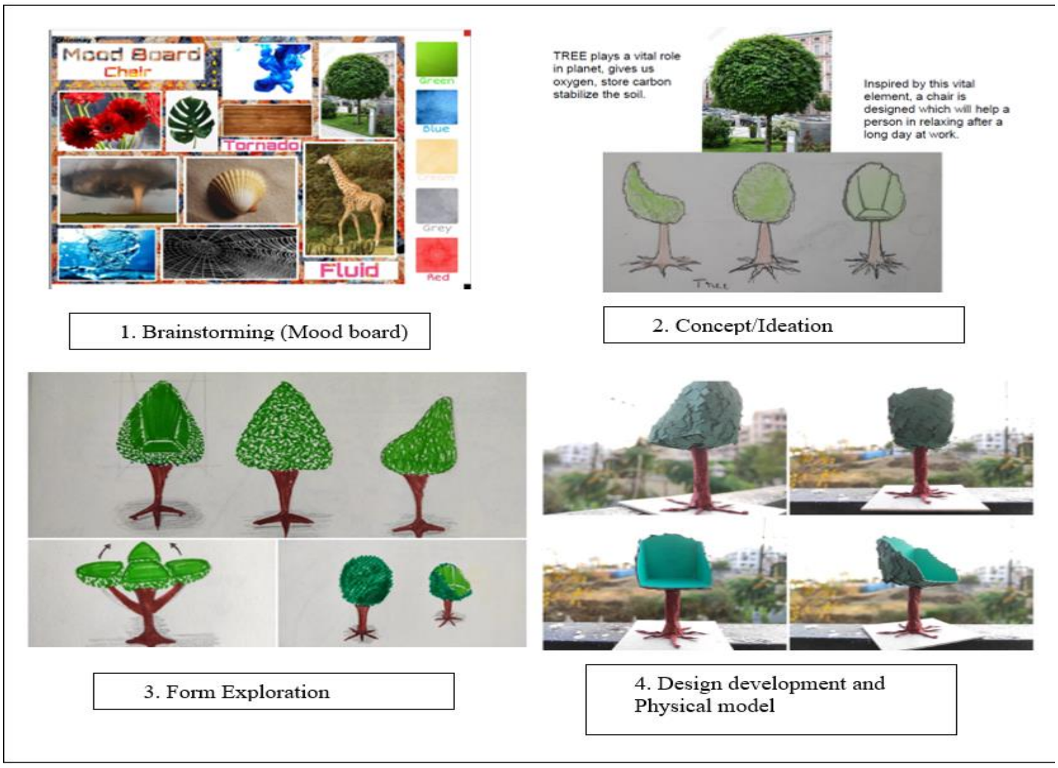

Figure. No.4 Design project completed through physical model making

Group B- CAD Model Making :
Students/Participants had completed their design project through CAD model making As shown below figures:

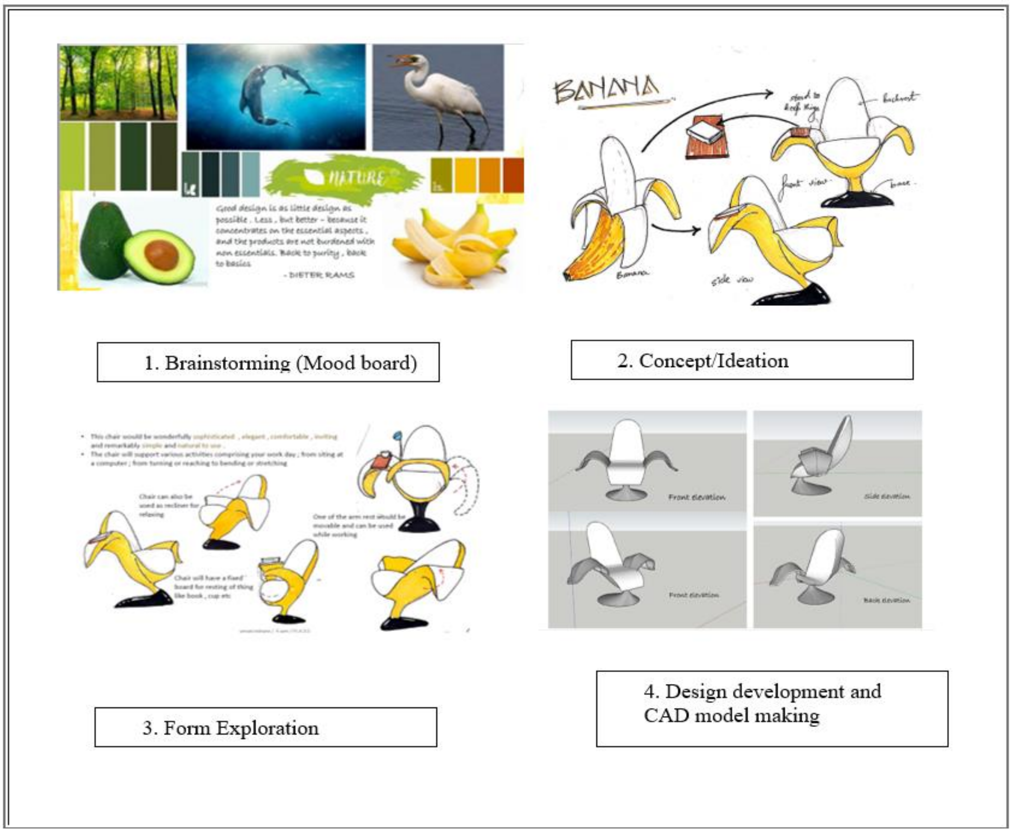

Figure. No.5 Design project completed through CAD model making

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4. Comparative synthesis of case studies and experiments - Model Making

Model making play an important role in the Product/architectural design project. Models can show how the entire object/building sits in the environment without showing all detail or it could highlight one interesting area of the product/building.

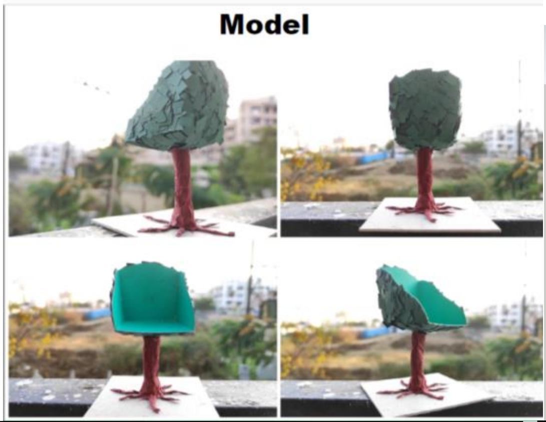

Figure. 6. Physical Model Making

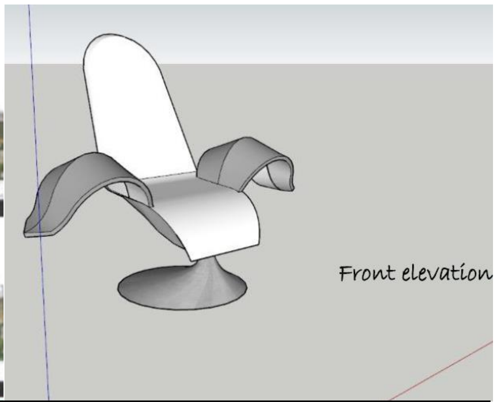

Figure 7. CAD Model Making

4.1. Observation:
1. With the help of physical model making, Novice students make their design very easy while 3D CAD model makes them difficult to understand.
2. Models are created by students as a means of testing and improving designs in 3D forms.
3. Models have a number of benefits, including their permanence, which allows them to communicate concepts about textures, form, texture, patterns, size, and colour in a quick and simple manner

4.2. Comparative analysis between Physical model making and CAD model making for beginners.
In conclusion, the making of physical and CAD models has benefits and disadvantages for novices. The decision is frequently influenced by the particular learning objectives, project needs, and preferences of the novice. Many designers believe that combining the two methods can result in a complete set of abilities that blends manual skills with digital accuracy and flexibility. Table No. 1 below provides a comparison of the PM and CM.

SN	Physical Model Making	CAD Model Making
1	To creating basic design forms for beginners is easier than in physical model making	To creating basic design forms for beginners little bit difficult in CAD model making
2	Preparing and developing a detailed physical model with realistic surrounds takes more effort.	Using CAD 3D modeling software to generate the model, however, makes the process much faster.
3	Physical models communicate better than their flat screen simulations because sculptural objects inhabit the real space of the viewer, while frames isolate imaginary spaces.	3D objects confront the viewer with their presence; interacting with the viewer by providing different appearances from different angles and reflecting lighting and images from the enclosing room.
4	The study model can provide a deeper understanding of the physical phenomenon	while the digital model provides powerful tools to transform or extend a design
5	Critical thinking ability is easily Developed in the beginners through physical model making	In CAD model making it will take more time for beginners
6	Physical model-making take more time more time as compared with CAD modeling in the design project.	CAD model-making takes less time as compared with physical model-making in a design project.

Table no. 1. Comparative analysis between Physical model making and CAD model

5. Result & Conclusion:

Students learned that both physical model-making and CAD model-making environments have the potential to create models for architecture instead of models like the building itself the final design results, and a survey the students completed assigned the workshop. While the majority of students preferred utilising physical modeling for rapid sketch exploration, we noticed that students were becoming increasingly interested in and enthusiastic about digital modelling. With more freedom to explore, students used physical modelling to create a wide range of materials and modelling processes, including clay, meshing, paper goods, glue, foam, wire, and Acrylic, to mention a few of them. Digital modelling involves a number of ideas and procedures that must be understood, which forces many students to rely on examples and lectures before they may experiment more freely. In order to teach more abstract aspects of computer modeling and physical models were placed next to one another and their similarities and differences were explained. We define two qualities of architectural models, which are illustrated through the creation of physical models: Modelling must allow for thought, be partially completed, and have an indicative infinity. Physical sketch models can explore potential alternate design outputs and possibly serve as inspiration. As Michael Ostwald (Downton 2007) writes: For designs in architecture to be helpful, they must continue to be disposable, ignoble things. They are not constrained by this; on the other hand, it is their inherent state and unique strength. To some extent, digital modelling demonstrates this easily transformable structure. Endless variants may be created by manipulating geometric elements. Modern modeling software frequently employs "visual styles" to create models that appear less polished, more illuminating, and "sketchy." When using parametric, correlated modeling, it is possible to create 'working' models which explicitly describe geometric restrictions and relations and enable the exploration of many design options by adjusting parameters. One acts within a constrained set of solutions, and the phrases they investigate are predefined. Digital exporting, especially in quantitative modeling, is predictable in nature, in contrast to physical modelling, which permits an open-ended investigation of design concepts while incorporating aspects like chance and serendipity. The difference in mediation is more due to its type than its intensity.

Physical modeling's relatively sluggish speed allows for time for thought and design modifications as the model becomes built. From that vantage point, rapid prototype development and file-to-factory production may be either too quick, preventing time for contemplation, or too slow: A typical design model may be printed in a few hours, according to the method of printing (SLS, SLA, etc.) its size. The process of representation and evaluation cycle may be restored by cutting this down to a couple of minutes, a moment, or perhaps an instant physical production of our digital model. A genuinely preliminary and fuzzy application of digital manufacturing techniques will be conceivable after they have lost their intrigue or even admiration and have become sufficiently ordinary. Raising awareness of the fact that design constitutes a mediated process, which can play it safe, and establishing an exploratory strategy that actively switches between many representative modes could be considered the first steps in the direction of modeling for Product design and architecture. A predictive model's strategy that actively crosses the boundary between the physical/prototype and computer worlds and modifies forms of representation might add an element of exploration and opportunity to digital modeling. Knowing the limits of digital media may change a CAD model's function from representation to an exploratory tool that inspires the design process — compared to a model of product design and architecture.

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