Model Making is to Induce Creative Skills Within Students of Architecture and Product Design

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Abstract

In this Paper, we explained about how students studying product design and architecture with benefit from model making. Detailing and materialisation procedures are commonly disregarded in design education when it comes to a systematic design process. In order to give clients a false sense of completeness, educators frequently advise students to concentrate on describing problems, coming up with creative design solutions, and presenting "nearly completed ideas" in the form of comprehensive and nuanced depictions. This paper also mentioned a methodical approach for design education and practise in selecting the top prototypes and models to encourage disagreement, originality, Careful attention throughout the detailing and realisation phases a step throughout the design process. Because during design procedure, as details are being finalised, students and young designers tend to gravitate toward tangible solutions and materialisation tasks are prioritised and pushed, the authors also suggest maintaining a rigorous process of concept development and ideation, as well as an intense cognitive and measure the different, for analysing design issues and coming up with solutions. The lack of hermeneutic inquiry and design reasoning in this rigid development process should be compensated for by the longer employing mock-ups and prototypes, divergence and converging processes throughout the refining and materialisation stages, as well as "apprenticeship" interactions between students and faculty.

***Keywords**:* Model making, Prototype, Design Process and materialisation

1. Introduction:

Models and prototypes are created during the design process to address the questions that designers have as the design is developed (Verlinden, J., & Horváth, I. (2007). asserted that the use of models and prototypes will indeed help designers run extra efficient conceptual frameworks, they are therefore an essential tool for such designers to develop their creativity in designing new things and modernising classic ones.

According to (Hallgrimsson, B. 2012). Model making and prototyping are among the utmost well-known besides approved methods used with designers to convey and visualise their design ideas, according to (Kelly,2001)., (Vandevelde, et al. 2002). Numerous scholars have written extensively about the purposes, benefits, and difficulties of utilising models and prototypes

(Kojima, T.1991) It is generally acknowledged since prototypes as well as models' useful tools for examining the function and aesthetics of a design concept. Additionally, with or without the involvement of stakeholders, concepts and models are used to improve interactions between both the designer as well as the client as well as self-reflection and different levels of detail throughout the design process. According to Charlesworth in design education, design students have traditionally utilised physical modelling to create and present their ideas (Charlesworth, C. 2007). Though, the advent of Analog visualisation techniques have been changed by 3D computer modelling techniques They were distinguished by a tedious, sluggish, besides messy creating procedure—into an efficient virtual design and prototype process. Charlesworth cautioned that employing CAD in the materialisation and realisation stages may present the designer with more difficulties and constraints than initially expected (Charlesworth, C. 2007). This is a result of instructors not providing design students with adequate information on the use and efficacy of designs and models, along with how these resources could encourage kids' sensitivity and inventiveness. Design thinking, communication, problem-solving, and project planning abilities may all be taught indirectly through experience rather than directly (Ledewitz, S. 1985) Otherwise put, it is challenging to enlighten "creating" to the pupils without involving them inside a process of experiential learning (Kolb, D, A. 1984). The multiple learning cycle that forms the basis for Kolb's learning theory offers a way to understand numerous learning choices in terms of two spectral axes. Active Experimentation - Reflection and Concrete Experience - Idea To create are two related concepts. (Goldschmidt, G. and Rodgers, P.A. 2013). In addition, Goldschmidt in addition Rodgers shown that additional knowledgeable students exhibit a supplementary systematic design behaviour and are more analytically engaged. (Romer et al. 2013) . His research supports this assertion since it demonstrates how a substantial 50% of the Less experienced students rely on sketches and representations heavily throughout the conceptualization phases but avoid conduct experiments during the final design stages to make things function. Charlesworth disputes some of the aforementioned statements, claiming that students use actual models while creating designs in their last year. (Charlesworth, C. 2007). In order to promote divergence and innovation as during detail through materialisation phases of the design phase, this paper provides a systematic way to educating design students just where find the best models and prototypes. This approach sits at the nexus of teaching, design education, plus modelmaking as well as prototype mentioned in figure no.1

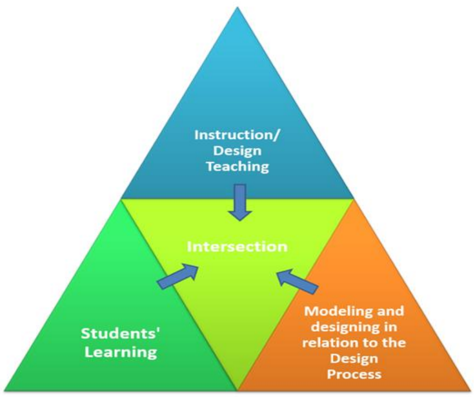

Figure.no.1 Intersection of learning, design education, and modelmaking and prototyping.

2. Importance of Model Making in Product and Architectural Design

In any area of building, but notably in design, where we occasionally see the end result, such as the architecture, before the creating process is complete, the presentation of new ideas is essential for beginning designers (Dunn, N. 2014). Before the project's design is sufficiently solidified to be built, a preliminary concept was produced from side to side to enable the students to study, modify, and evaluate process ideas in growing feature (Mills, C. B. 2011). This phase allows models to be extremely flexible, allowing designers to creatively correspond their speculations (Hallgrimsson, B. 2012). Students build models as a way to test and refine concepts presented in three dimensions. Models offer a lot of advantages, including their permanence, which makes it possible for them to quickly and clearly convey ideas about textures, shape, pattern, scale, and colour. The volume of either a notion is to some extent determined by the size necessary at various phases of building production. Given that models may show how a design has evolved in relation to a city framework, a landscape, a renovation project that is adding to an accessible structure, or even the ability to be built as full-scale replicas, which are sometimes referred to as "prototypes," Individual models have also been utilised extensively throughout history to remedy deficiencies in perceptual knowledge (Schilling, A.2018). This is due to the fact that models have a knack for providing quick access to all of its components as well as comprehensive and overall perspectives. defects in a model that must be fixed. Since models are a likely rich establishment of data with up to three measurements within which to close data, working with them is a significant improvement. having the capacity to employ a variety of "back" word-derived characteristics, including size, shape, colour, and surface. Because of the model's complicated "culture," it is possible to simplify the "encoding" of each data snippet, which will shorten the time it takes for us to understand it. Models are also made for the understanding of shape, size and articulation of form. students had been explored ideas as shown below figure no.1 and 2

Fig. no. 2 shown surface finishing

Fig. no.3 Students learning model making process

3. Models and prototypes enhance learning and teaching approaches with reference to design elements with materialisation phases:

All agreed that maintaining academic standards in today's higher education presented significant difficulties for many professors. Effective teaching strategies would boost students' participation in the proper learning activities, claims (Biggs, J. 2012). Educators and Students need to think more carefully and considering carefully which learning methods Such situations should be promoted owing to developments in globalisation. They ought to establish a shared understanding of "what" ought to be taught and "what" ought to be investigated and tested initially. emphasised that only a shift in thinking in the advancement of design education requires that we move away from a traditional and Today's

industrial designing educators should adopt a completely new and innovative teaching method due to the change from a tight vocational concentration on "making" to a wider multidisciplinary emphasis upon "design thinking." (Faerm, S. 2013). If educators wish to properly lead and nurture the students, they must also re-examine their approach to teaching by developing far more intimate, one-on-one connections with each student. In light of this, educators need to be skilled at not just explaining and passing down project-relevant design techniques (Faerm, S. 2013). but also, at recognising and using the connections between research and instruction. To properly appreciate how to impart knowledge about design, consider the following methods: an expert relationship, reflective and practical learning, and methodical and procedure design training. Students are taught a precise development approach of issue resolution in systematic and process-oriented design training (Roozenburg, N.and F. M., Eekels, J.1995). Its key concept in such a process is the engineering process' mechanistically inspired systematic and predictable design methods. Here, the major issue is broken down into more manageable subproblems and subprocesses that may be resolved utilising problem-solving techniques (Simon, H.A. 1996). Students frequently mistake interaction, divergence, and convergence for some sort of "formula" for design even though they occur in a rigid development process. Therefore, when it comes to designs and prototypes, distinct styles of expression are committed to different stages of the process. As an illustration, to assist the best result, a non-functional concept model is created. a foam sketch model is developed to support the idea generating phases. This rather prescriptive approach to using models to assist in developing might limit original thought to some extent. Additionally, it will result in a rather limited investigation of design details and the materialisation domain. In quality of learning, a methodical and process-oriented design approach revealed a number of issues. Students find it difficult to carry over and integrate their learning from one level to the next when a design approach is somewhat linear. They find it challenging to go back and make certain early design choices that may have enhanced the design's quality (Srinivasan, B.1996). In response to the philosophy of logical problem-solving, the author makes the case from this angle for a true representation that is more constructionist strategy (Schön, D.A.1995) activities and efforts of designers or developers should concentrate on Because each design challenge is distinct and challenging to generalise, that is necessary to reinterpret and improve the situation through highly speculative interactions with the situation and other factors. The designer's methods must be founded on information that has been learned, experience, and logic. This strategy is consistent with Kolb's theory on experiential learning, which makes specific distinctions between learning styles based on two spectral axes. The linked axes are "Active Experimentation - Reflective Observation" and "Concrete Experience - Abstract Conceptualization." Interpretive reasoning is where the technique of teaching design through mentor-apprentice interactions has its roots. Such a method of creating and studying design will encourage the using a larger range model development as well as prototype methodologies along with tools both terms of diversity and exploration. The essential job here for just the teacher and Students must get a consistent and developing awareness of design product, its background, values, and functions until all parties agree that saturation has been achieved. With the master's assistance, the design trainee must, in order to reduce variation, establish a clear connection between its objectives, strategies, and solution since the possibilities accessible and the possible alternatives are practically limitless. (Coyne, R., & Snodgrass, A.1992). A research-based having to learn method is necessary because it assumes that the designer's open to interpretation judgement and prior involvement in the design phase are essential qualities. In this strategy, the "trainee" is encouraged to watch the "mentor" in action and also has instant access to a "mentor's" greatest latest ideas and suggestions. In exchange, the "mentor" might appoint the pupils to help him look for fresh information.

Methods: Active learning through model making (ALTMM)

We created the active learning strategy in this method (ALTMM), as indicated in the below fig 4.

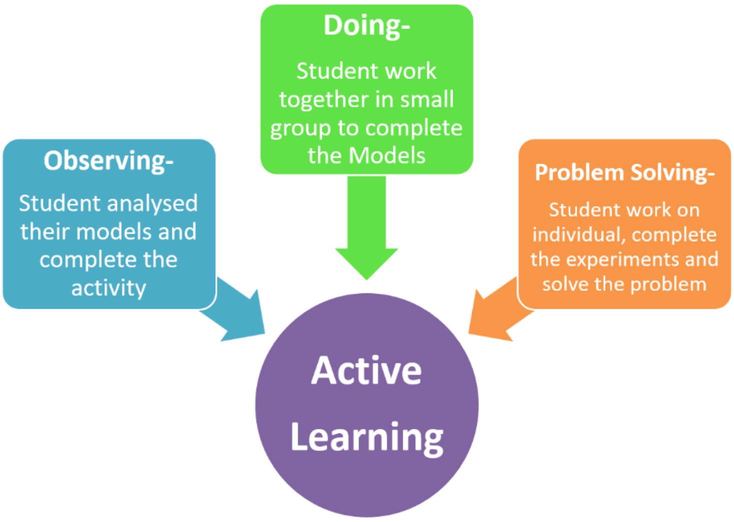

Figure no.4. Active learning method model making (ALTMM)

ALTMM- assists students in developing their conceptual design using three methods: observations, through doing, plus problem solving. It also refers to a educational strategy that uses engaging learning processes that are tailored to the requirements and interests of the learners. The ALTMM strategy is successful in stimulating learners' sense of curiosity. Learners in this technique learn critical thinking abilities as well as how to express themselves creatively.

4. Physically prototype as well as models as teaching aids in the design process

Industrial design education places a strong emphasis on modelmaking and prototyping. Every student studying industrial design should possess the fundamentals of model-making in order to investigate form, composition, and utility from concept creation through detail design. Early involvement in modelmaking may improve a analytical awareness of a design phase by "junior professionals," in addition to their practical knowledge of innovation and design judgement (Steffany, E.2009). Because of their interactive and tactile properties, models and prototypes are thus being revisited and receiving greater recognition in industry than 3D computer and Virtual Reality models. These characteristics are crucial for

stakeholder communication in design (Steffany, E.2009). Evans has suggested in his research that virtual reality, haptic feedback interfaces, and CAD might eventually take the role of physical modelling as a tool for design creation (Evans, M. A.2004). claims that although virtual reality techniques and technologies are complementary to physically prototype, that creative industry has proved to be open to

using them. The Authors of this paper concur with Charlesworth (Charlesworth, C. 2007) and Kelly (Kelley, T.2001). in favor of the presence of 3d objects and also against using virtual models to solve design issues. To help design educators transmit knowledge and abilities to design learners while preventing misunderstandings even during materialisation through detail phases of something like the design process, new instructional methods and tools are required. In light of the fact that these technologies make it easier to conceptualise and implement the finer details of the finished product, product design instructors and students should revaluate the value of three-dimensional models. The below mention figure no.5 explained the product design process which will help the designer for their design solutions.

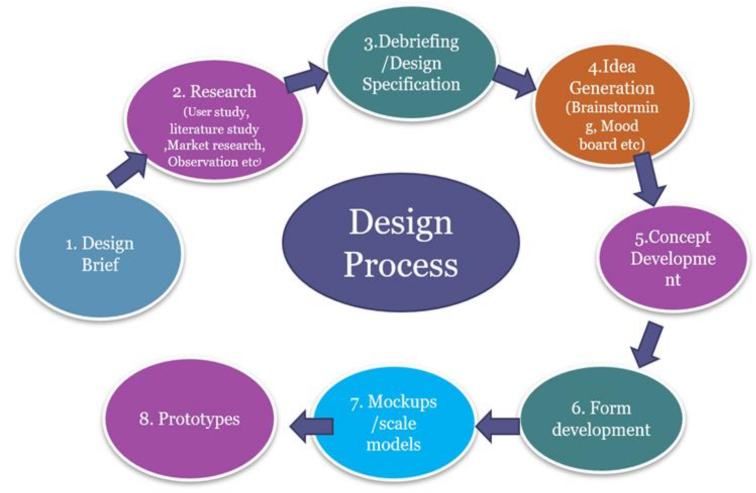

Figure. no.5 Product Design Process

To enhance collaboration among design team and gain a better understanding of the potential applications with physical prototypes as well as models throughout the detail developing and materialisation phases, this study suggests numerous learning principles for 3D visualisation. The objective is to instil in design students a sense of urgency to create final design concepts with excellent details. The materialisation and detailing tasks of designers can be greatly aided by the application of creativity techniques in design processes. Hsiao and Chou proposed a design methodology that is driven by creativity and is used in learning environments much like it is in market (Hsiao, S.W. 2004). They argue that integrating creative, scientific, and future development results in an efficient technique for

product design. Furthermore, they created the "Sensuous Association Method (SAM)," a technique for creativity based on human beings' inherent capacity for sensuality, with the primary goal of generating original ideas to support individual association and stimulation among designers (Hsiao, S.W. 2004).

Hasirci & Demirkan additionally proposed a creative design approach that was based on the five phases (5Rs) of O'Neill & Shallcross' Rapid Thinking framework (Hasirci , Demirkan 2010). The Institute of such New South Wales too has adopted Green's Major Project Development Model, which comprises seven steps and is applied to educate art and design (Green, L. 2007). Three creative development models are compared in Figure 6 with different phases of the creating process and also to fundamental human behaviours. The adoption of certain cutting-edge techniques by humans in a number of operational activities that support both SAM and MPD theories and methodologies is then explicitly studied. According to a review of the literature, these three innovative techniques have helped to shed light on how complex prototypes plus models can encourage innovation and synthesis in design, but especially through the finishing and materialisation phases.

Sensuous Association Method (SAM) Hsao et al. (2008)		**Adapted 5R's Sensational Thinking Model of O'Neill and Shallcross** Hasirci and Demirkan (2010)		**Major Project Development Model (MPD Model)** Green (2007)	
Human Senses	**Operation**	**5 R's stages**	**Operation**	**Phase of MPD**	**Operation**
Looking: Look at the involved things	Gather group of team designer in informative and creative environment	**Readiness:** activity that being open on possibilities	Imagery, ideas searching and observation.	**Product Planning** (PP): determine a new product idea	Literature search , Benchmarking, SWOT analysis,
Thinking : Think about origins and evolutionary trends	**Discussions begins:** thinking logically about the origins and evolutionary trends of target product	**Reception:** To experience fully and observe with all senses	imagination, generation, idea selection, refinement evident	**Task clarification (TC):** negotiating brief with the client	Objectives-tree method, Function analysis
				Concept Generation (CG): creative design concepts	Brainstorming, Concept selection, Morphological
Comparing: Compare "what you see" with "what you think"	**SAM:** participant has to compare their associations with information/pictures observation and contemplation	**Reflection:** Remembering activity and allowing time for internal interaction	evaluation, idea development, enriching, expanding discovery	**Evaluation and Refinement (ER) :** analytical and creative tasks are evaluated	House of Quality , Design by drawing, CAD, Design review
				Detailed Design (DD) : developing and validating concept	CAD , Value Engineering, Robust design
Describing: design Describe your mental image	must be described in a sensuous phrase, and written down by the recorder.	**Revelation:** Focusing and pattern recognition.	develop and enhance the idea	**Communication of Results (CR):** Communicate detail concept to client via 2D / 3D media	Design drawings, Renderings, Prototypes
Stimulation: designer's creative inspiration is increased through interaction	members' interactions will stimulate each other's creative inspirations in a highly conducive environments.	**Recreation:** To determine full contents and express it by various methods, such as drawing	final representation for missing parts, finishes.	**Preparation for Production (PP) :** determine the needs of product production.	Revised cost visibility, statistical process control, Fault tree analysis, CAD

Figure 6 : Three creative techniques modes with proposed operations borrowed from (Hsiao, S.W., and J.R. Chou, 2004) , (Hasirci and Demirkan 2010). and (Green, L. 2007).

5. Discussion.

To summarise, this study focused on three primary issues. These include (i) pedagogy in design teaching, which aids educators in determining the range and order of learning activities that are most suited to their pupils; (ii) model creating and design in relation towards the design process, that investigates suitable prototypes and models during the product design process; and (iii) implementing current or creating new strategies for students to aid in their understanding of information management. By including these components, We hope to assist design instructors better understand how to help students learn to generate precise innovative solutions as during materialisation phases of the designing process by using genuine physical models. The use of prototypes will broaden students' thinking patterns and models, and they will understand that divergent, convergent, and reflective design processes ought to be disregarded throughout the designing process's final phases. Therefore, rather of putting too much emphasis on final presentations, students are urged to spend more time and effort throughout the materialisation and detailing stage exploring physical models and experiments into the creative space This necessitates that design educators place a greater focus on methodologies, processes, and tools in their lessons on materialisation and modelling. Some techniques, approaches, tools, both cognitive. It should encourage creative, iterative, and analytical cognitive processes, both in tone and in form or graphically evident. Numerous studies have shown that designers will grasp form, function, and Those that utilise physical models like a productivity tool throughout the design process build more accurately than those that do not. The design phases themselves of both the design phase are when industrial design students have a tendency to help them grow concepts more through sketches, renderings, and three - dimensional CAD modelling than through actual modelmaking and prototyping. They fail to see how, particularly in the closing stages where design confirmations are required, exploring the optimum solution Using appropriate designs and prototypes would improve rather than diminish their cognitive design abilities. They consider model construction to be time- and money-consuming. Improved model development and prototype techniques used during the detail creating and materialisation phases, according to literature reviews, increase students' sensitivity toward developing well-defined, sure quality items. As opposed to using CAD tools, such To achieve so, the industrial design process should be creatively integrated with modelmaking and prototype methodologies. When tackling poorly specified challenges, Goldschmidt and Rodgers emphasised that teachers should impart organised and methodical design procedures to their pupils. However, across all phases of the design process, these methods should encourage inquiry rather of enforcing rigid methods of thinking concerning design, design should encourage experimentation, contemplation, and iteration. Given this situation, educators are faced with the issue of helping students arrange their design process so as to enable enough time for details while also stressing the significance of it for producing high-quality designs. The issue is that students tend to gravitate toward tangible solutions rather early in the design process once focus is placed on detailing and materialisation efforts.

6. Conclusion

Reviews of the literature indicate that improved model development and prototype procedures used during the detail creating and materialisation phases increase students' responsiveness to generating well enough and excellently quality items. This is in contrast to employing Model making and CAD tools. This places a challenge on teachers to help students arrange their design process so that they have enough time for detailing and to emphasise its importance in generating "award-winning" things. The longer divergence must compensate for the stringent development cycle and convergence procedures used in the high quality and materialisation phases utilising prototypes, in addition to "apprenticeship" interplay between students and professors to support hermeneutic investigation and design reasoning.

The physical model is a great artefact for the interaction of all design kinds for beginning students, while CAD modelling is particularly helpful for senior students' design projects. Physical modelling tools have developed into a distinct field of study as well as a creative practise with unique supplies, equipment, and methods.

To make up for some shortcomings in concept communication, models are often utilised. Models are incredibly flexible tools for the design process, for doing research, and for developing and introducing three-dimensional designs and students have been fostered through the physical model-making process used to explore form in design.

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