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E-B Environment - Behaviour Proceedings Journal

MEE 2.0: ICLT2022

International Virtual Colloquium on Multi-Disciplinary Research Impact (3rd Series)
International Conference of Logistics and Transportation
Best Western i-City Shah Alam, Selangor, Malaysia, 05-06 Oct2022

e-IPH e-International Publishing House Ltd., United Kingdom

Designer Perception and Design Thinking in Industrial Ceramic Product Development

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Abstract
This paper discusses the methods used to conduct designer perception and design thinking in industrial ceramic product development. The designers themselves struggle to clarify how they make the association that immediately them to be the outcome and why those decisions are rational because the thinking behind design is not completely comprehended. This research attempt to identify product design development in critical design situations, empirically test the design thinking process towards industrial ceramic design processes and establish an innovative technique for capturing the ceramic designer's thinking process. Exploiting a mix of aesthetics, ethics, and knowledge, design thinking is a contemplative longing to maneuver a new schematic in design development.

Keywords: Design thinking, Form-giving, Ceramic Design, Product Development.

DOI: https://doi.org/10.21834/ebpj.v7iSI9.4260

1.0 Introductory the industrial ceramic designs

Ceramic product design is a way to create the most functional, practical, and aesthetic product systems out of ceramic materials. It is a conceptual, behavioral, and reality-based creative process. Design is a creative process and designers' use of creative thinking empowers them. In the ever-changing market environment and market demands, ceramic design as design cannot survive without creative thinking. The unique design of ceramic products is not only an important part of quality improvement but also a requirement of ceramic products. Designers who play a key role in the development of ceramic product design can appreciate material properties, take full advantage of technological limitations, and recognize that technology can greatly enhance innovation in ceramic product design.

Rapid design changes, limited product development time, expensive raw materials, and unavailability of optimal models for designing new products are fundamental problems in the ceramics industry. With the continuous development of society, the new needs to replace the old, and people need to engage in self-mediation to awaken themselves to be freed from the old slavery (Y. Hongjun and N. Guangfang, 2013). The creative design of ceramic products gives vitality to ceramic products. This is also an important reason why ceramic products have an edge in the fierce competition in the market (M. Kumar, J. D. Townsend, and D. W. Vorhies, 2015). With the improvement of people's living standards, pottery is not only a tool to meet people's living needs, but also a zeitgeist art object that reflects culture, personality, and emotions (C.-F. Chien, R. Kerh, K.-Y. Lin, and A. P.-I. Yu, 2016). Innovative thinking has therefore become the subject of the design of ceramic products. The ceramic design brings the product to life. When the innovative design of ceramic products is accepted by society, it is not only the decisive factor for the dramatic improvement of the value and quality of ceramic products, but also gives

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DOI: https://doi.org/10.21834/ebpj.v7iSI9.4260

ceramic products a competitive advantage in the ceramic industry. It is also an important prerequisite for Innovative design thinking extends people's design thinking, stimulates design inspiration, makes ceramic products achieve the perfect combination of craftsmanship and decorative practicality, and promotes the development of ceramic product design can do.

The birth of new ceramic products begins with creative thinking. Creative thinking is the process by which people gather all kinds of related information, mix it up, and process it according to scientific thinking using association, imagination, and inspiration to come up with fresh and original solutions to problems. It is a process of thinking. Competition in today's market is becoming more and more intense and only innovation can sustain the development (V. Nitin, I. A. Khan, and S. Vikran, 2006). Promoting the social value of ceramic products is the prerequisite for the development of enterprises. The innovative thinking of ceramic product design is implemented in terms of materials, shape, decoration, function, and other aspects, and the new design concept expresses the trend of the era and gives products the unique style needed (S. Y. Sarah, K. K. Lam, and E. A. E. Smith, 1999)

2.0 Mitigation ConMaTech Issues in ceramic product

Ceramic product design is the method that uses ceramic materials to create the most functional, practical, and aesthetically pleasing product system. It is a creative process that involves concepts, actions, and realization. Ceramics are now more than just an instrument for supplying people's necessities; it is also a work of art that captures the spirit of the moment and expresses culture, personality, and emotion. (C.-F. Chien et al., 2016). Consequently, creative thinking has been included in ceramic product design. The ceramic design gives products vitality. Ceramic product design is a creative process, and designers' use of creative thinking is what gives them power. Once the innovative design of ceramic products is accepted by society, it not only becomes the deciding factor for the leap in the value and quality of ceramic products but also a crucial condition for this creative process (Yueming He, 2012).

Designing a ceramic product is one of the most intellectually and skill-intensive human endeavors. Design can be categorized according to the processes that relate to design challenges and the creativity involved (Hui Tang, 2002). The initial phase of the design process can be distinguished from subsequent phases. In this initial phase, designers commit to comprehending the problem, defining the criteria from their perspective, and generating basic ideal solutions. In contrast, throughout subsequent phases, designers focus primarily on concretizing and deliberating solutions' particulars. The initial phase or process is referred to as the conceptual design phase or process due to the widespread perception that the conceptual design process includes important design characteristics (Hui Tang, 2002). A new era of inventive design has begun in ceramic product design today. Innovation is essential to the growth of new products (H. Yanhua, 2011). Theoretically, research on creative design thinking in the development of ceramic products contributes to individuals having a better understanding of ceramic product design theory (L. Xing, 2013). Finding ways to raise the level of ceramic design is one of the most crucial responsibilities. In terms of user-product relationships, design is one of the most efficient ways to add value. It is influenced by the designer's knowledge structure, design level, attitude, and level of existing technology. Ceramic products can meet the needs of life, but today people are constantly developing new materials and striving to make ceramic products more diverse. The design elements of modern ceramic products include, which includes materials technology, and modeling, and are dominated by functional factors, which are very important for materials and modeling.

The design strategy offered a triangulation design analysis of ideation activity, which is concepts, material, and technical. The implementation of three elements is based on studies by Nilsson (1998). He addressed that producing product design, especially in the specification, must incorporate the processes of material and technical, therefore is supported by research from Anwar (2016). Where several ceramic designers have been investigated in their case study and reported to be consistent with what Nilsson claimed, however, it is more of a concept, material, and technical research approach (Anwar, 2016). The three-element of ideation represents for: "concept represents the design by standard," "material represents the design by formulation," and "technical represent the design by treatment." The emphasis is on three elements based on the task undertaken in any product without a standard format, such as a tableware product. Based on three-element significant issues in industrial ceramic design components can be clarified into standard- formulation-treatment (SFT).

3.0 Experimenting with ablution as ceramic design proposals

The component for product design is the design orientation (Needham & Hill, 1987) to provide a preliminary view of the product to be created. The first aspect identified for design needs is the analysis and design definitions of the problems faced by consumers, and this has been recognized through in-depth research conducted by the designer. After issues met by the user are identified, the second aspect is the study of the product design survey information related to the preliminary survey of the product (Taib & Hanafiah, 2006) to resolve the problems (Jalil, 2000). The product planning process also involves creative brainstorming ideas and problem-solving methods (Ilevbare, Probert, & Phaal, 2013; Jin & Li, 2009) by obtaining information from multiple sources. Besides that, exploration, and comparison of the design analysis are also part of the need to design products (Tayal, 2013).

The product design purpose of this study is an efficient space for an ablution place in the mosque. In this study, an efficient ablution place is a place of prayer with the appropriate measurement system with the scale of the human body, is built with the right material, and has suitability. An ablution place is a space that is important for Muslims to perform the ritual ablution before performing prayers. Practice ablution before performing prayers is the main practice of all Muslims. This study provides an understanding of the function performed in the ablution space. For the followers of Islam, ablution is a state that is a prerequisite to praying. This study will identify the basic design

of ablution places in mosques and evaluate the advantages and disadvantages of the design based on ablution places and provide recommendations for the design of a proper place of ablution.

According to Polit and Hungler (2004), methodology refers to ways of obtaining, organizing, and analyzing data. The methodology decision depends on the nature of the research question. Research methodology can be considered the theory of correct scientific decisions. The process used in research methods is; to identify the problem, collect the data, evaluate, and synthesize the data and finally provide results that are reliable and valid. This research study ultimately focuses on issues related to the design of tubs for performing wudhu' (ablution) of Muslims in Malaysia. The design development process addressed the design considerations and requirements for the globally designed extinguishing station for any type of user. In addition to determining whether the ablution is easy and comfortable to perform, not allowing any part of the body to dry out should also be considered for proper ablution. The torture begins with washing both hands, washing mouth, face, and forearms from wrist to washing elbow.

Fig. 1: Ablution space design issues

The research design is the major methodologies of the research study, the strategy, the plan, and the structure of conducting a research project (Cormack, 1996). This is common sense and clear thinking necessary for the management of the entire research endeavor. Hence to achieve the best control and validity of the study, we decided to use experimental design as an approach to investigate the ergonomics level achieved by a human through performing wudhu'. Experimental design is the process of planning a study to meet specified objectives. Planning an experiment properly is very important to ensure that the right type of data and sufficient sample size and power are available to answer the research questions of interest as clearly and efficiently as possible. Experimental design allows the researcher to get strong conclusions about cause and effect because the researcher manipulates or directly control independent variable in a natural situation.

In this study, problem scenarios and reference system specifications were developed from the necessary information gathered from different organizations through personal interactions, interviews, surveys, and direct internal analysis. After gathering information about the wudhu facilities used in the mosque, specification for better functioning of the system is structured. The next step is to develop a conceptual model of the designed system and conduct an evaluation of the stated conceptual model. If the conceptual model is accepted, a prototype will be produced for further testing and evaluation prior to implementation. The implementation will be conducted after the prototype is decided appropriately.

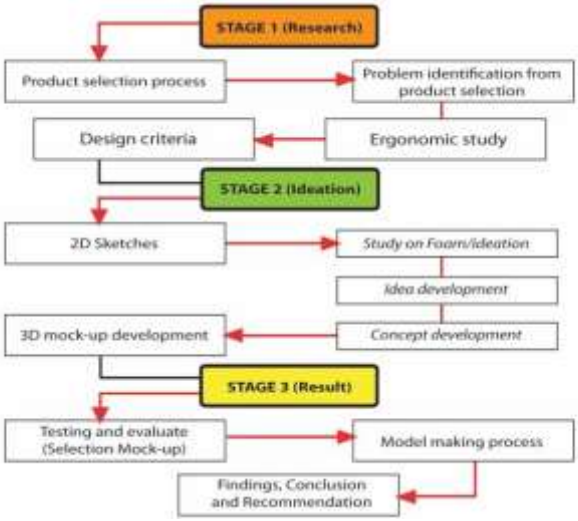

Fig. 2: Design development of Project Proposed Flow Chart

4.0 The Design Issues

Based on the first observation of the ablution place, we found that cleanliness, safety, and neatness are not a concern in the ablution place and space and this statement also supports by the interview sessions with imams and the safety officer. This study also found that human body posture while performing wudhu' must be considered to ensure the characteristic of consumers' comfort and body stability while performing wudhu. Of this problem, wudhu's facilities must be improvised for consumers' safety and can give more comfort to consumers to use it. Besides that, the improvised design for this ablution space must be consistent and compatible with the criteria that involve all components in improving comfort for users: cleanliness, safety, and neatness (Raif et al., 2022).

Ablution facilities have not been designed for convenience for users, on the other hand, worship facilities must consider safety and comfort factors for users. Physical constraints are addressed by an ergonomic design with seats, footrests, and armrests in the ablution place. In addition, the combination of standing and seating creates a comfortable feeling for the user. The standing position is used to wash the face and hands, while a chair is required to wash the feet and the handrail on the wall is used to get up after a burn. The results of this study will become a guide for the preparation of designed ablution places in mosques, thereby increasing comfort and safety, as good design contributes to the prevention of injuries as well as improving the overall quality of life.

The ideal design of the ablution place is adapted to overcome the users based on anthropometry. When maintaining the bent posture for a long time, there is a potential risk of back pain. Therefore, the design of the ablution place is made to avoid the bowing position. Aman (2017) and Raif et al. (2022) explains that design should consider body parts such as forearms, neck, and legs. In addition, improved posture reduces the difficulty of performing ablution (Anwar et. Al., 2017). It has also been reported that anthropometric data such as height and horizontal arm length are the basis for the design of the ablution place (Anisah et al., 2019; Hasbi et a;., 2020). In the wudhu facility design, the anthropometric approach will be employed as the ergonomic technique. Anthropometric dimension measurement is purposed for fitting of design between the wudhu facility and the users.

Fig. 3: Diagram of Human Body Posture (Anthropometric) in Architect's Data.
"Ergonomic Design Of Wudhu Facility For Disables"
(Source: Agus Mansur and Didi Tri Wicakson, (2008)

The selection of the anthropometry body dimensions was considered according to their significance and usefulness for the development of designing the sitting workstation and ablution workstation. The description for each anthropometric dimension is referred from the book entitled Body space: Anthropometry, Ergonomics and the Design of the Work by the Malaysia Standard, MS ISO 7250-1:200814. The analysis is shown in Fig. 4 below.

Fig. 4: Body storming analysis while performing ablution

5.0 Form giving in ablution design gestalt

Design is the interplay between what designers want to achieve and how they meet needs (Suh, 2005). This is a creative process, but it has led to a principled process. However, finding the right or specific design principles to use during the development of an idea and until the idea is fully built is difficult. It is important to recognize that knowledge of structural considerations has the potential to understand the structure of a design (Anwar, 2016). Related to this discussion, Abidin, Sigurjohnsson, Liem, and Keitsch (2008) define the importance of form-giving influence in design. This supports the translation of solution principles as embodied designs into final product form. The study of form-giving roles has been used in Scandinavian countries for almost two decades and applied at specific stages of the design process. Design leads to an understanding of physical principles. How the character can influence shapes and forms. Start from a technical perspective and find a way to understand structural stability; shape and elements; or forces and moments. Forming can also be viewed as the activity of determining possible required shapes (and sizes) of complete assemblies and components (Hubka & Eder, 1996).

This study will evaluate product form design from the point of view of Product Gestalt theory. An imaginative process involving complex visual distinctions in product prototyping. To deal with questions regarding consumer psychological preferences for product shape, it is essential to build an effective decision support system for designers. These standards should be applied to evaluate the quality of the design of the product appearance, as the Gestalt theory of the product provides an essential view of visual perception. Therefore, the design process approach proposes the development of major design constructs centered on the perspective of ceramic industrial design, which characterizes the semantic representation of the design in an interrelated design concerning the creation of forms. Design thinking and the design process as a tool for designers to characterize the affordability-based design approach to designing innovative products in critical design situations and to empirically examine the design thinking process towards product properties in the design process of ablution places.

Nilsson (1998), addressed producing product design, especially in the specification, it must comprise the process of material and technical, therefore is supported by research from Anwar. Where several ceramic designers have been investigated in their case study and mentioned to be consistent with what Nilsson claimed, on the other hand, it`s more of a concept, material, and technical research approach. (Anwar et al, 2015). This study shows that thru design thinking and design process through gestalt development and semantic representation would be a method for product design creation in a critical situation. In this context, it can be considered how designers, enhance, and implement gestalt with semantic factors in the creative development process.

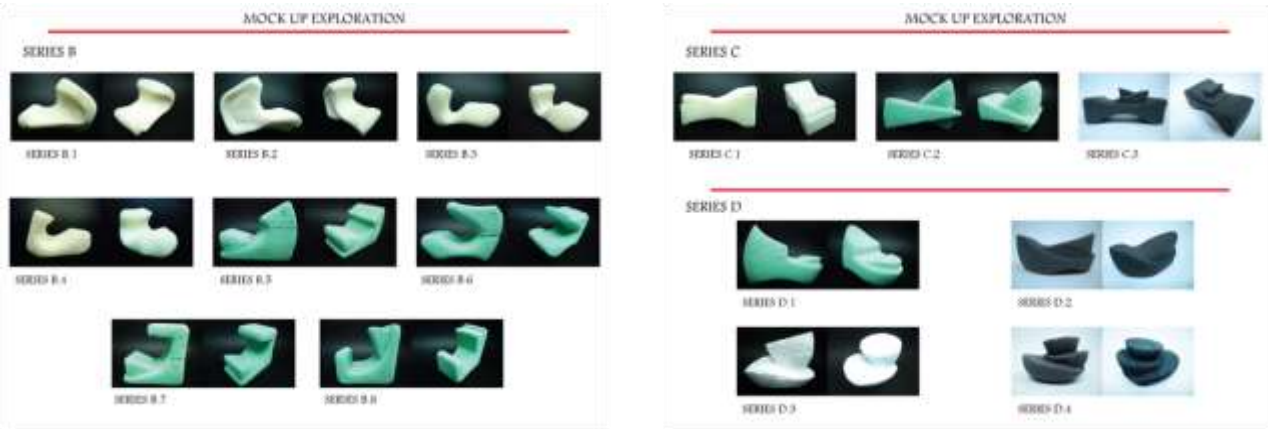

Fig. 5: Form evolution based on a design issue

6.0 Function Mean Analysis in Design

Function Means Analysis is a highly structured approach to creating, selecting, and documenting system design concepts (Anwat et al., 2017). The resulting table is used to display all potential design options simultaneously, making it easy to apply selection/rejection criteria to help create complete system concept solutions. The basic idea is to consider the functions that the system performs and identify all the means to achieve these functions. The approach used for this study is a chart as shown in Figure 5. As systems become more complex, it is no longer possible to create an entire system design at once. In addition, fixing part of the system design before properly considering aspects that have not been designed opens the door for undesirable behavior to emerge. Function Means Analysis allows a group (or an individual) to create and represent a "complete" solution space before any solution choice. This allows for a systematic, transparent, and traceable design process. If done with some discipline, it will save design decisions, which in turn will be of great help to those who need system support (Winston Churchill, 2006). In addition, Function Means Analysis can be applied throughout the design process. It can be used to help establish the overall concept through the detailed design of individual components. Function Means Analysis is based on top-down design through system functional decomposition. It begins with defining system functions at the top level. Different ways to achieve this have been identified. It is important that the functions defined are at the same level of generalization. means that self at this level can

also be general in nature. After the deal solutions have been selected, the analysis of the feature means can be re-applied at a lower level of detail.

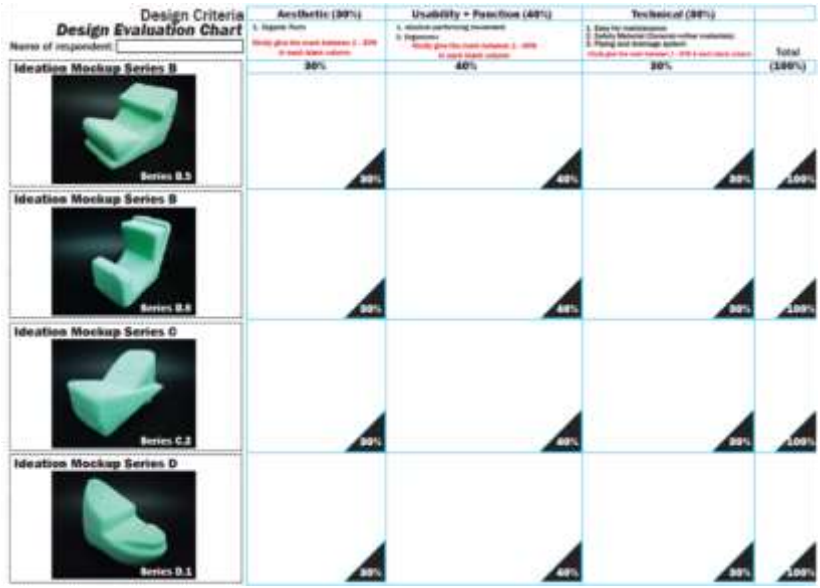

Fig. 6: Evaluation Chart for possible design

Principle solution requires design-inspired approaches and the ultimate design structure of design ablution conveys the design theory of form-giving (Anwar et al., 2015). Shahriman (2008) defined the concept of qualitative structure and quantitative structure throughout the methodology related to form-giving. It clarifies that the form of visual elements is one of the properties of form that create tone texture, and convey interest and visual meaning. Their importance becomes apparent through their use in creating both two-dimensional (2D) and three-dimensional (3D) images and shapes. In an understanding of the use of basic entities of visual elements such as points, lines, planes or surfaces, and volumes, as well as the organization rules and principles for mounting assemble layouts or structures (Akner Koler, 2000). This element then will become a guide on generating the ablution form. The process of casting human posture which is based on random sampling selected from any design during form evolution as shown in Figure 6 clarifies that the form of visual elements is one of the properties of form that create visual meaning.

The main function of ablution model components is clearly constructed to meet the needs of ablution implementation. By means, we understand the potential functional solution, with which all four-ablution principles are compulsory to perform (consisting of face, hand, head, and toe). Becoming the most important sub-functions. The concept generation here is achieved as a solution by connecting the ablution process for each sub-structures which is known as the basic structure (Tjalve, 1979). This is the phase where the potential system of concept solution is traced out. However, Tjalve defines, this as the most important parameter in the creation of a product but still, nothing is yet to decide. The quantified structure on the relative arrangement of ablution elements (four types of body posture) is optimized and specified with ablution design (four mockups). This stage required a large amount of quantified structure (QS) to assess ablution design and its compatibility with the user's need.

Fig. 7: Mockup design with human proportion while performing ablution.

As recommended by Burge, three or six criteria are enough to avoid enthusiasm and concentration. Here, the ablution design should select all four ablution principles, and perform on combinations of the four mockups mentioned with the option of human postures. These selections decide based on the primary ablution requirement from Evaluation Chart (Figure 7). Before we can decide to move into the Concept Selection phase, it's required to evaluate the selected criteria and organized them in order of importance. This is the stage we can establish a basic arrangement. The reason is to explore possible arrangements, and continual refinements until the ablution design seems satisfactory. Evaluation of the solution can embark into concept development as an embodiment of a completely feasible solution

to the design problem (Liem, 2004). This is the phase that Liem's characterized as 'possible versus feasible', "global versus detailed', and 'specific versus holistic'.

The critical design situation, as described by Anwar et al. (2015), is where the configuration of form-giving design in a humane process (designers and users) can grasp not only a goal but also include thoughtful and enthusiasm, for the transcendent ablution design. This activity comes after the important elements and criteria are determined. It is up to the designer to select how the Function Means Table of Ablution's (see Figure 7) roles should be considered while describing this activity in order to narrow down the available alternatives. Similar to nature, designers frequently employ solution hypotheses to advance their comprehension of the issue (Cross, 2006). The conceptual design phase, which follows the clarifying phase and establishes the principle solution for the ablution design, should be used to produce as many different solutions as possible. In this situation, the designer's design evaluation is crucial to ensuring that the product's appearance, expression, and impression still allow the aesthetic (formgiving design), usability (ergonomic), and technical (prototype development) requirements to be satisfied within the forms and shapes created.

Design Alternative	IDEATION 1				IDEATION 2				IDEATION 3				IDEATION 4			
	Aesthetics	Usability	Technical	Total	Aesthetics	Usability	Technical	Total	Aesthetics	Usability	Technical	Total	Aesthetics	Usability	Technical	Total
1	28	35	28	89	24	35	28	87	33	33	20	86	20	25	20	65
2	28	35	25	88	30	40	30	100	20	25	30	75	25	20	20	65
3	20	30	25	75	20	25	20	65	28	30	25	83	15	35	20	70
4	15	20	15	50	20	20	20	60	15	25	15	55	25	20	20	65
5	25	30	30	85	15	30	20	65	15	30	15	60	20	30	25	75
6	15	30	20	65	30	40	30	100	15	25	15	55	20	25	20	65
7	20	30	20	70	27	40	28	95	23	33	25	80	21	30	21	72
8	20	30	27	77	25	36	28	87	24	33	24	81	28	35	24	87
9	25	34	25	84	30	30	28	88	15	27	27	87	20	25	22	67
10	20	28	25	73	25	29	25	79	25	29	27	82	30	40	30	100
11	25	32	27	84	25	30	20	75	23	23	15	61	20	25	15	60
12	20	30	20	70	20	25	15	60	23	33	20	76	25	35	25	85
13	15	10	15	40	25	40	30	95	15	25	15	55	30	35	30	95
14	20	30	25	75	25	25	27	77	22	28	23	73	27	30	25	82
15	15	15	15	45	30	35	25	90	33	40	30	100	20	20	20	60
16	20	30	10	60	30	38	25	93	33	40	33	100	25	20	5	50
17	20	20	20	60	15	20	15	50	30	40	33	103	15	15	15	45
18	20	20	20	60	15	20	20	55	33	34	33	99	10	30	15	55
19	10	30	15	55	15	20	20	55	32	35	33	99	20	20	20	60
20	18	15	20	53	23	27	25	75	27	28	29	84	20	20	15	61
21	28	20	15	61	27	29	28	84	28	27	29	84	18	16	20	53
22	25	30	20	80	28	25	27	81	28	27	26	81	15	20	18	53
23	20	30	25	75	25	30	20	75	23	35	25	83	20	20	10	50
24	25	20	5	50	30	35	25	90	33	40	33	100	20	30	10	60
25	20	25	22	67	21	20	18	59	27	33	23	83	20	27	20	67
TOTAL	513	659	101	1691	607	741	599	1947	598	767	606	1961	535	647	485	1667
		%	67.84			%	77.88			%	78.52			%	66.69	

Fig 8: Designer's Design Evaluation: Aesthetic (Formgiving Design), Usability (Ergonomic), Technical (Prototype Development)

7.0 Designers think in Industrial ceramic form-giving design

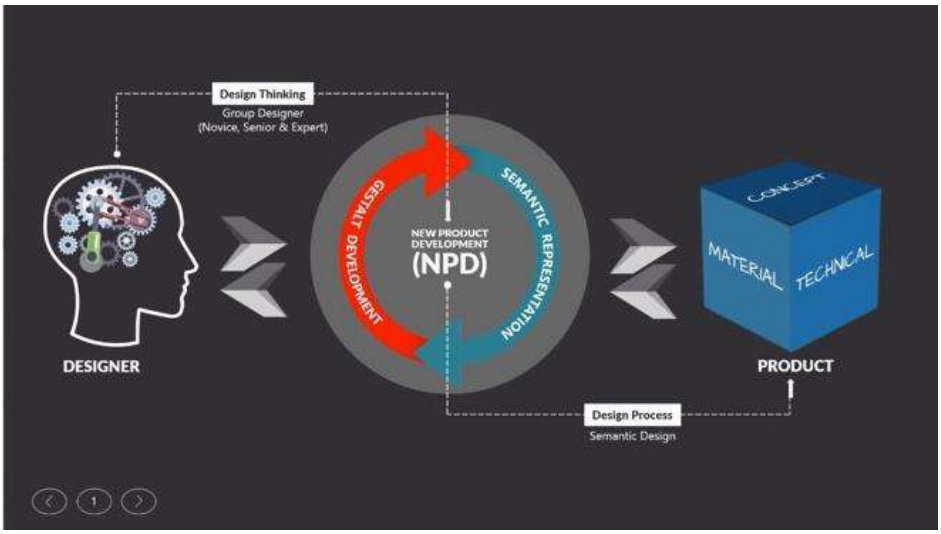

Fig. 9: Designedly way of thinking toward industrial ceramic design product development

The design process approach suggests the production of fundamental design structures with an emphasis on the ceramic industrial design perspective and design semantic representation in relation to form creation. To describe the affordance-based design method for innovative product design in challenging design settings and to empirically verify the design thinking process towards product gestalt in the industrial ceramic design process, ceramists use design thinking and the design process as a tool. In order to learn more about the design thinking process toward gestalt development and semantic representation, particularly in the industrial ceramic design process, the diagram (conceptual framework) in Figure 9 illustrates how the process of defining a design activity in this research. In addition, the conceptual framework specifies the link between the three components concepts, materials, and technical. Nilsson studies are the foundation for the realization of three specifications (1998). He discussed how product design, particularly in the specification, must include

the technical and material processes, which is supported by Anwar's research. On the other side, it is more of an idea, material, and technical research method, where various ceramic designers have been examined in their case study and indicated to be consistent with what Nilsson asserted. (Anwar, 2016). This framework's primary research focuses on design thinking, design process, gestalt development, and semantic representation, which can be used to generate product designs in urgent circumstances. In this context, it is possible to think about how teams of designers, each with a distinct level of design thinking, might improve and use gestalt and semantic variables in the process of creative growth.

8.0 Conclusion

It is hoped that this model can be connected to relevant design areas and product design for form design created based on the research cited in this paper. What a designer needs to accomplish and how the designer satisfies the need to interact to create a design (Suh, 2005). Although it is a creative process, it ended up being a procedure based on principles. Finding the right or precise design principle to employ during the ideation, development, and eventual construction of an idea is difficult, though. Abidin, Sigurjohnsson, Liem, and Keitsch (2008) define the importance of the form-giving impact in design in conjunction with this debate. It helps designers comprehend how shape and form are affected by character, which is a physical principle. Beginning from a technical perspective, it discovers a way to comprehend structural stability, shape and element, force, and moment. Additionally, organizing the potential and necessary forms (and sizes) for the entire assembly and the components can be done through form-giving (Hubka & Eder, 1996). Design typically involves development, and it explains various actions that aid in fully realizing the concept and concepts. Through the exploration of ideas, this process must be demanding and fulfilling.

As suggested by Andrea (2013), exploration analysis to look into design innovation acknowledges the significance of qualified human resources in the field of design, where universities and education systems should be aware of the growing importance of design in the coming years as a source of competitiveness for firms. While Jamaludin (2013) and Anwar et al. (2015) discovered that designers can achieve design goals and target their audience by concentrating on the semantic element and syntactic analysis, it is crucial to comprehend the relationship between fundamental form and the product character as shown in Figure 10. The study looks at how local design influences such as ignoring design trends, new material discovery, manufacturing technology, and corporate branding capabilities lead to low commercialization value and sustainability. Its extended to be as Aesthetic-Usability-Technical (AUT) to sum the important profile to be considered while performing new design product development.

Fig. 10: Concrete level of AUT of ablution design

The research's main question focused on the extent to which current designer creativity contributed to the successful creation of innovative commercial product concepts. The focus studies additionally look into how 3D design form exploration and direction practice is being developed without ignoring corporate value, competitive products, and commercial value (Anwar et al., 2020). This study will serve as a fresh starting point for the local design expertise of Malaysian product design, which is crucial to raising performance and contribution in Malaysian industries. It will also offer new guidance for the design of education policy in Malaysian higher education institutions, which could be strategically improved to be in line with the direction of industrial development, particularly the New Economic Model and NKRA.

Acknowledgments

We would like to acknowledge The Ministry of Higher Education Malaysia and Universiti Teknologi MARA (UiTM) for financial support. This study was conducted in the National Design Centre, Faculty of Art & Design, UiTM. We would like to acknowledge you're your

generous participation in the research. Fully appreciative Malaysia Ministry of Higher Education for the financial support under FRGS File No. 600-IRMI/FRGS 5/3 (449/2019).

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