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Research Article:

The Challenges and Initiatives of Teaching Product Design's Course Online During the COVID-19 Pandemic in Malaysia

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ABSTRACT

Due to the COVID-19 pandemic, most of the schools and universities around the globe, including Malaysia, were compelled to cease their operations and migrate to online teaching and learning environment. Along with this 'forced approach' to learning, the educators were faced with several barriers and challenges that need to be addressed. This paper intends to determine the challenges of teaching and learning Product Design courses in Malaysian universities using the online environment during the COVID-19 pandemic. It also highlights some of the strategies and initiatives adopted and adapted by the lecturers of this course in surmounting those challenges. Using a real-time video interview, data were collected from ten respondents from various faculties of Malaysian higher education institutions offering product design courses. The findings of the study point to a range of difficulties in teaching Product Design courses online, including the need for more delicate interactions to ensure efficiencies in teaching and learning design courses, as well as the evaluation methods to achieve design learning and design outcomes

Keywords: Product design, COVID-19, challenges, teaching and learning

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INTRODUCTION

Novel Coronavirus' (COVID-19) latest outbreak has caused a worldwide outcry due to its deadly existence. The outbreak of COVID-19 has been critically evaluated by the Malaysian government as the World Health Organization (WHO) set the protocol that must be followed to prevent the spread from spreading widely. Prime Minister, Tan Sri Muhyidin Yassin therefore declared the implementation of the first Movement Control Order (MCO) on 18 March 2020. The MCO has a big effect on Malaysia's education system where most of schools and universities have to close their operation, impacting millions of students. Across Malaysia's public and private universities, polytechnics and community colleges, this is equivalent to 4.9 million school students and 1.2 million in higher education institutions, including some 130,000 international students (Salleh et al., 2020). Hence, online learning is used as a solution for educators to share their knowledge using e-learning or other platforms as education needs to be conducted during MCO. While having advantages such as time flexibility, environment flexibility and lower costs, there are few barriers and challenges that need to be addressed particularly for the Product Design course. Consequently, this paper aims to provide a factual report focusing on the complexities of teaching online Product Design courses and proposes a few steps which can be implemented as a solution. The research is based on four domain of Product Design course: (1) Theory-based subjects; (2) Studio-based subjects; (3) Computer Aided Industrial Design subjects (CAID) subject; and (4) Model-making sessions. The data gathered through a real-time video interview with 10 respondents from eight Malaysian higher education institutions that offer Product Design courses.

LITERATURE REVIEW

There is various literature abounding with definitions of design. For instance, Simon (1977) defined design as an activity performed by any attempt to transform an existing situation into a desired new situation. Meanwhile, in design science perspective, the activity is defined as the creation and implementation of concepts with requirements leading to the design of the physical form of the product in order to better meet the needs of the customer (Ulrich, 2003). Globally, design plays a crucial role in providing a solution to a specific problem, with a collection of specifications for certain purposes and under certain constraints (Warell, 2008). As the need for products is old as humanity, product design discipline however is a relativity new field of knowledge. The terms Industrial Design and Product Design are often used interchangeably. In accordance with the concept of product design, industrial design is defined as a creative activity aimed at determining the formal qualities of industrially generated objects. These for-real qualities involve external attributes, but they are essentially structural and functional relationships that transform a system into a cohesive whole from the producer's and user's perspectives (Moody, 1980). The word 'Industrial Designer' was coined during the Industrial Revolution to describe people who helped to shape new ideas about the industry. Later, the word 'Product Designer' helped them reflect on why they were making it and for whom they were making it. As a result, many design schools provide this course under various names and various

sub-domain of specialty, but it essentially accomplishes the same goal (Monö et al., 1997). Product design is defined as the creation of the gestalt of useful products intended for mass production, with the aim of adapting them to human and their environment. According to Rodgers and Milton (2011), product design frequently blurs the boundaries between specialised areas such as lighting, decor, graphics, fashion, interaction design and industrial design to improve the quality of life, whether at home, in the workplace or in the public domain. In facts, the word 'product' is widely, and confusingly, used to describe everything, from a life insurance scheme to a new savings account. Yet, wherever 'hardware' and people interact, product design is found relevance (Rodgers & Milton, 2011). Figure 1 shows an example of product design.

Figure 1. Lemon squeezer by designer Philippe Starck (Adapted from Holm, 2006)

According to Warell (2008), no distinction can be made between the principle of designing and making the products. Traditional craft-based societies did not familiarise themselves with the drawing or modelling practice before the activity of making the products. For example, a blacksmith forges a sword by working directly at an extremely high metal temperature without making any sketches or sword drawing at first. On the contrary, the activity of designing and making products in the modern industrial societies has changed. The procedure of making something can only be executed after the process of designing is completed. In this case, the activity of sketch or draw the sword will be first completed before the activity of forging the sword can start (Warell, 2008). Based on this example, the process of making products can only be executed at least after what the process of design has to achieve. The prescription of design has to provide clear and systematic information of the products that is to be made. A detail information such detailed dimensions, materials, and colours are the discretion involved in the process of making artefacts.

Nowadays, product design discipline has evolved as an important role to produce an innovative product through research innovation. One of the current approaches to enhance the quality of human and values is to integrate the human factor into product design by understanding the human behaviour, difficulties and needs (Abdullah Sani et al., 2019; Chumiran et al., 2020; Kamil et al., 2019a, 2019b; Mohamed Kamil et al., 2018; Sani et al., 2020). During the pandemic COVID-19, the field of product design has made a significant contribution to the development of great design thinkers (Fu &

Liang, 2020; L. Liu et al., 2021; Ramos-Paz et al., 2020; Sterman et al., 2021; Wijaya et al., 2020). Furthermore, there were numerous and disparate literature discussing the extend of knowledge in product design (Abidin et al., 2009; Dorst, 2009, 2011; Kamil & Abidin, 2013; Mohamed Kamil & Zainal Abidin, 2015; Valkenburg & Dorst, 1998; Zainal Abidin et al., 2014). Thus, it is critical to emphasise that product designers have evolved into important contributors to businesses and scientists, who are mutually receptive to the acceptability, sustainability and social desirability of additive manufacturing as a means of contributing to a circular economy. Figure 2 shows an example of innovative product designed for trans-radial amputees.

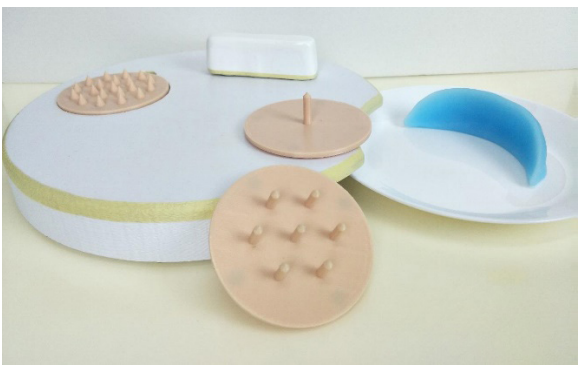

Figure 2. Innovative chopping board design for trans-radial amputees (Adapted from Mohamed Kamil et al., 2020)

As a multidisciplinary profession, product design education is influenced by new trends based on advances in various scientific fields. Engineering (technology, techniques, materials, processing), ergonomics (operation, safety, usability, sensation), business (marketing, management, planning, corporate identity), aesthetics (form, visualisation, style), and social, environmental, and cultural issues are elements that covered in the curriculum (Cartier, 2011). However, different region and countries may have a different approach in conducting the programme. For instances, in the United Kingdom, art schools have been primarily responsible for the education of industrial designers. Meanwhile, in the United States, product design programmes are heavily focused on engineering domain, teaching product function. Cartier (2011) argue that students should be trained in at least three areas of competency as part of a rigorous product design education programme:

1. General characteristics, such as problem-solving abilities, organisational skills, and the ability to adapt to rapid changes, etc.
2. Product design skills and knowledge – design thinking and procedure, design methodologies, visualisation skills and knowledge, product creation methods, production, materials and processes, design management, environmental awareness, model-making, etc.
3. Knowledge integration – strategies of system integration.

Meanwhile Norman (2013) also argue that a classic product design, which is a type of applied art that necessitates a thorough understanding of forms and materials as well as skills in sketching, drawing, and rendering for styling and forms, is still in demand. However, the change in design practice due to new fields such as applied cognitive and behavioural sciences for understanding human cognition and emotion, as well as more experimental design, necessitates the development of a new generation of designers who are knowledgeable about science, technology, people, and society. Even though those criteria are comprehensive and numerous, each product designer ideally should possess all of the skills mentioned above.

According to Malaysian Qualification Agency (2018), undergraduate product design course being offered by numerous governments or non-government universities, with different course name within a various sub-domain of specialty, such as:

1. Bachelor of Fine Arts in Product Design by Universiti Sains Malaysia (USM)
2. Bachelor of Arts and Design in Industrial Design by Universiti Teknologi MARA (UiTM)
3. Bachelor of Design in Industrial Design by Universiti Putra Malaysia (UPM)
4. Bachelor of Applied Arts and Design in Industrial Design by Universiti Islam Antarabangsa Malaysia (UIAM)
5. Bachelor of Science in Industrial Design by Universiti Teknologi Malaysia (UTM)
6. Bachelor of Industrial Design by Universiti Sultan Zainal Abidin (UNISZA)
7. Bachelor of Creative Technology in Industrial Design by Universiti Malaysia Kelantan (UMK)
8. Bachelor of Engineering in Product Design Engineering by Universiti Malaysia Perlis (UNIMAP)
9. Bachelor of Applied Arts in Design Technology by Universiti Malaysia Sarawak (UNIMAS)
10. Bachelor of Arts in Furniture & Product Design by First City University College
11. Bachelor of Arts in Industrial Design by Lim Kok Wing University
12. Bachelor of Engineering Technology in Product Design by Universiti Kuala Lumpur (UNIKL)
13. Bachelor of Arts in Industrial Design by Asia Pacific University of Technology & Innovation
14. Bachelor of Manufacturing Engineering Technology in Product Design by Universiti Teknikal Malaysia Melaka (UTEM)

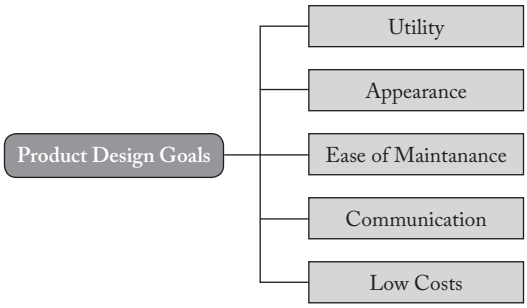

Figure 3. Product design goals (Adapted from Dreyfuss, 2003)

Product design students in Malaysia were trained in the study of drawing development, presentation, computer skills, sculp and form, model-making skills, gain a basic understanding of materials, and manufacturing techniques including finishing. Their ability to convey thoughts and ideas visually is being evaluated during the learning cycle to facilitate the process of concept advancement. Despite the fact that the thoughts and ideas could be originate from different perspective of disciplines, the student may create the greater part of the design solutions such as concept sketches, 3D renderings, mock-up, and scale models or prototype throughout the development process (Ulrich, 2003). As they step into the world of industrial practices, an extra exposure such as the fundamental of engineering, advanced manufacturing or fabrication processes, and basic marketing practices were received. At the end of study, product design students should be able to facilitate five goals (see Figure 3) when developing new products as proposed by Dreyfuss (2003):

1. Utility:

   The product's human interfaces should be safe, easy to use, and intuitive. Each feature should be shaped so that it communicates its function to the user.

2. Appearance:

   Form, line, proportion, and colour are used to integrate the product into a pleasing whole.

3. Ease of maintenance:

   Products must also be designed to communicate how they are to be maintained and repaired.

4. Low costs:

   Form and features have a large impact on tooling and production costs, so these must be considered jointly by the team.

5. Communication:

   Product designs should communicate the corporate design philosophy and mission through the visual qualities of the products.

Even though different institutions in Malaysia may have different subjects' name and curriculum arrangements, product design course generally can be divided into four domains.

Theory-Based Product Design Subjects

Theory-based product design subjects explore the notion of theory, philosophical, and principles related with product design such as ergonomics, design history, material and processes, design thinking, user experience in design, emotional in design, and design research methodology. Such subjects are usually presented in face-to-face mode in lecture halls throughout a series of lectures, presentations and discussion (see Figure 4). The assessment for the subject is normally done by series of quizzes or formal examinations.

Figure 4. A lecture on theory-based product design subjects (design thinking) being conducted in the lecture hall before COVID-19 pandemic

Studio-Based Product Design Subjects

Product design students are required to complete studio-based projects in order to gain experience with the design process, which includes task clarification, idea creation, assessment and refining, comprehensive design of desired ideas, and result communication (Cartier, 2011). Specifically, studio-based product design topics explore the notion of design theory, philosophy and principles related with product design but with greater weighting on the execution of design tasks/projects and technical elements such as sketching and rendering techniques, workshop and model-making techniques, application of design principles in studio-practice project, furniture model-making, product model-making and automotive model-making. The execution of design task/project and vocational elements usually being held in studios, labs and workshops (see Figure 5). The evaluation for the studio-based product design subjects usually being done through series of design presentation (critics) and project assessment.

Figure 5. Studio-based product design subjects (sketching and rendering techniques) being conducted in the studio before COVID-19 pandemic

Computer Aided Industrial Design (CAID) Subjects

Heading towards Industrial Revolution 4.0 (IR4.0), CAID subjects are very relevant in product design education. CAID subjects have shown substantial improvements over the years, especially in the efficacy and quality of work and the product manufactured (Setiadi et al., 2020). The existence of CAID subjects makes it easier to modernise computer-based engineering drawings with sophisticated, relevant features and applicability. Throughout the product design course, CAID subjects usually being delivered in face-to-face mode throughout a series of lectures, demonstrations, and technical consultation in computer labs (see Figure 6). The evaluation for the subject usually being done through virtual or non-virtual design presentation (critics) and project assessment. For instances, a subject such as technical drawing (AUTOCAD), 3D Modelling (Autodesk Inventor/Autodesk 3D's Max/Rhinoceros/Catia/ Alias/Keyshot), and digital presentation techniques (Adobe Photoshop/Adobe Illustrator/Autodesk Sketchbook).

Model-Making Sessions

Models and prototypes are considered essential design tools that have been in use for decades. Models can act as a link between ideas and the real world, and they are often more effective at communicating complex ideas. Prototypes and models serve a variety of functions, including serving as a demonstrative method of the final project and allowing for input during the design process for revision and development. As a result, they've been a part of design education for over a century (Greenhalgh, 2016). Models and prototypes have traditionally been made by hand in many design educational environments, using a range of materials and techniques such as wood, paper, foam and clay (see Figure 7). Model-making has developed into rapid prototyping, three-dimensional (3D) printing technology, and other additive manufacturing techniques as commercial machining equipment and training have improved. These technologies have allowed designers and

engineers to build 3D physical models from 3D computer models in a fraction of the time and at a fraction of the cost of hand-built models. Thus, the use of technology in the model-making process has increased significantly in educational institutions in the last few years. Model-making session typically conducted in face-to-face style through a series of technical consultations and processes for model-making. This session is a significant element for the outcome of studio-based design task/project of the students.

Figure 6. A class on CAID subjects (3D's Max) being conducted in the computer lab before COVID-19 pandemic

Figure 7. Model-making process (foam sculpturing) being conducted in the workshop before COVID-19 pandemic

The global higher education environment has faced major challenges as a result of the COVID-19. Specially in product design education, the COVID-19 pandemic has thrown the programme into disarray, especially in highly interactive, hands-on design classes (Y. Liu et al., 2021). As argued by Martins (2020), a variety of stories of adaptation and non-adaptation are likely to be the focus of scholarly posts, planning sessions, online forums, and political discussion in the coming years. During the MCO, product design classes in Malaysia that were previously been conducted in maker spaces, creative design studio and fabrication laboratories has change to Online Distance Learning (ODL) as a solution for educators to share their knowledge. Although there are benefits such as time flexibility, environmental flexibility, and reduced costs, the lack of a collaborative design studio and a collaborative campus culture can have a major impact. For instant, Yu and Da Silva (2021) argue that ODL not only helps students to become comfortable with the product design learning process in a setting where physical laboratories are unavailable, but it also allows them to investigate the product design's problems and limitations, as well as find new materials handling challenges. However, it cannot replace the experience when operating the product design process in a real environment. Yu and Da Silva (2021) also stressed that there are few studies on how to continue with such a design course online, and proof of the success of the online active learning approach is lacking. It is then vital that for product design educators to rethink traditional teaching techniques, and the COVID-19 pandemic shall provide an opportunity to try out new routes.

METHODOLOGY

The study is based on qualitative data collected from 10 respondents from eight faculties of Malaysian higher education institutions offering product design courses. Table 1 shows the demographic profile of each respondent. Purposive sampling was used to select respondents in order to obtain saturated data. The respondents are lecturers in product design course which were selected based on criteria as follow: (1) teaching domain and (2) teaching experience.

Due to social distancing, semi-structured interview was conducted using real-time video platform (Webex). Each respondent has been asked open-ended questions regarding the challenges of teaching product design course using online platform during the COVID-19 pandemic. The questions were being asked based on four domain of product design course: (1) Theory-based subjects; (2) Studio-based subjects; (3) Computer Aided Industrial Design subjects (CAID) subject; and (4) Model-making sessions. Adapted based on work by Creswell (2009), each interview session was recorded digitally and the explicit explanation including the abstract thought of the respondents from the interview data were systematically coded into information categories, which made out of three stages of coding: (1) open coding; (2) axial coding; and (3) selective coding. The coding process were executed by attaching a label to segments of data, and sort them to provides a way of making comparisons with other segments of data.

Table 1. Demographic profile of respondents

Institutions	Respondents	Teaching domain	Teaching experience
Faculty of Arts and Design, Universiti Teknologi MARA	1	Studio Based Subject: Transport Design, Model-making	9 years
Faculty of Innovative Design and Technology, Universiti Sultan Zainal Abidin	2	CAID Subject: Rhinoceros 3D Studio Based Subject: Product Design Project Theory Based Subject: Material Technology	11 years
	3	CAID Subject: Rhinoceros 3D, 3D Max, Blender	11 years
Faculty of Creative Technology and Heritage, Universiti Malaysia Kelantan	4	Studio Based Subject: Prototype Model-making, Design Studio	7 years
	5	Studio Based Subject: Design Studio CAID Subject: Rhinoceros 3D, Keyshot	9 years
Faculty of Engineering Technology, Universiti Malaysia Perlis	6	CAID Subject: Catia	6 years
Faculty of Manufacturing Engineering, Universiti Malaysia Perlis	7	Studio Based Subject: Automotive design	11 years
Faculty of Design Innovation, Lim Kok Wing University	8	CAID Subject: Technical Drawing Studio Based Subject: Industrial Design Studio, Presentation Techniques Theory Based Subject: Design Research, Design History	6 years
Faculty of Technology Management and Busines, Universiti Tun Hussein Onn Malaysia	9	Studio Based Subject: Furniture Design Theory Based Subject: Furniture History	9 years
School of The Arts, Universiti Sains Malaysia	10	Studio Based Subject: Product Design Theory Based Subject: Ergonomic, Material and Processes	9 years

For instance (see Table 2), in a study of respondents' perception towards the challenges and initiatives of teaching theory-based product design subject using an online platform, the researcher coded the respondent's utterance's selected emphases and retrieved the utterance's attributes. In this work, open coding begins with the creation of simple descriptive labels or characteristics of utterance's analysis. An excerpt of open code from one of those utterance analyses may be seen in the 'Open Codes' column.

Table 2. Sample part of open coding from a study of respondents' perception towards the challenges and initiatives of teaching theory-based product design subject using an online platform.

Respondents' index	Time	Transcriptions	Attributes	Open codes
Respondent 1	13:25	*It was very challenging to fully get their commitment since they were at home with the camera off, who knows if they really pay attention to our lectures…, it is totally different compares to face-to-face mode.*	1. Challenging to fully get students commitment 2. Students were at home with the camera off 3. Online mode is different compares to face-to-face mode	Compared to face-to-face mode, it was challenging for students to commit in online platform since they are turning their camera off throughout the session.
Respondent 2	25:23	*Not everybody will commit to our lectures, most of the time they just join the session with the camera off*	1. Limited commitment 2. Join lectures with the camera off	There were limitations to assure students commitment throughout the online session since students joined the online platform with the camera turned off.

The open codes are then categorised into more abstract conceptual categories (axial codes). Selective coding, in particular, entailed sorting and relabeling comparable coded data reduced from open codes into conceptual categories. The code is refined during the cycle to get the optimum match, and more than one axial code might be produced throughout this process. Furthermore, data that was 'split' or 'fractured' throughout the open coding process will be strategically reassembled. The 'axis' is a category derived from open coding at this level. A 'dimension' is a phrase used to describe a category, and one of the goals of early coding is to find these dimensions and arrange the open codes along them. For instance, in Table 3, Table 2's open codes have been renamed and reorganised in respect to one another. After determining a category or dimension, the researcher may need to go back to the data and recode the data in relation to the emergent concept summarised in the category or dimension.

According to Muller and Kogan (2012), choosing which codes (from the axial codes) to develop further necessitated a selection on what themes to investigate. The information was derived through selective coding by analysing the interrelationships that arise among the categories created in axial coding (Creswell, 2009). In order to produce explicit information, the selected coding maintains only relevant and applicable variables to the core variables during the process (see Table 4).

Table 3. Sample part of axial coding from a study of respondents' perception towards the challenges and initiatives of teaching theory-based product design subject using an online platform

Respondents' index	Time	Open codes: Categories of information	Axial codes
Respondent 1	13:25	Compared to face-to-face mode, it was challenging for students to commit in online platform since they are turning their camera off throughout the session.	It was challenging for students to commit in online platform for a theory-based product design subject as compared to face-to-face mode since they may cheat by turning their camera off throughout the session.
Respondent 2	25:23	There were limitations to assure students commitment throughout the online session since students joined the online platform with the camera turned off.	There were limitations to assure students commitment throughout the theory-based product design subject since students joined the online platform with the camera turned off.

Table 4. Sample part of selective coding from a study of respondents' perception towards the challenges and initiatives of teaching theory-based product design subject using an online platform

Respondents' index	Time	Open codes: Categories of information	Axial codes	Selective codes
Respondent 1	13:25	Compared to face-to-face mode, it was challenging for students to commit in online platform since they are turning their camera off throughout the session.	It was challenging for students to commit in online platform for a theory-based product design subject as compared to face-to-face mode since they may cheat by turning their camera off throughout the session.	Difficulties in dealing with students' commitment to participate as students do not need to be physically present in the classroom.
Respondent 2	25:23	There were limitations to assure students commitment throughout the online session since students joined the online platform with the camera turned off.	There were limitations to assure students commitment throughout the theory-based product design subject since students joined the online platform with the camera turned off.	Difficulties in dealing with students' commitment to participate as students do not need to be physically present in the classroom.

FINDINGS AND DISCUSSIONS

Based on the analysis of interviews, the challenges and initiatives of teaching product design course using online platform during the COVID-19 pandemic are described as follow:

The Challenges and Initiatives of Teaching Theory-Based Product Design Subject using Online Platform

The experience of using a real-time video platform such Webex, Google Meet, Skype and Zoom to deliver lectures, hosting discussion and presentation session for theory-based product design subjects is not the same as sitting in a real classroom or lecture hall. This is in line with the study conducted by Salleh et al. (2020) which indicate that interacting with, and learning from a fellow human was found to be challenging, and therefore compromised the effectiveness of learning and teaching. Respondents mostly found that students tend to be distracted and lost focus when lectures were delivered using a real-time video platform, leading to a lack of understanding of the content of the lectures. Nevertheless, the majority of respondent experience difficulties in dealing with students' commitment to participate in the online classes as students do not need to be physically present in the classroom. Most respondents believe that there is a need for a systematic online attendant registry to overcome this challenge. For example, the participation of students who have not engaged in real-time video discussion on particular timing shall not be recorded by using cut-off time features. The lecturer can therefore identify the 'absent' student and act accordingly. As a solution, some respondents do not rely on 100% real-time video to give a lecture, but instead provide their students with pre-recorded lectures (see Figure 8). To ensure students' understanding, a simple online quiz is given at the end of the pre-record lecture, and students need to respond promptly.

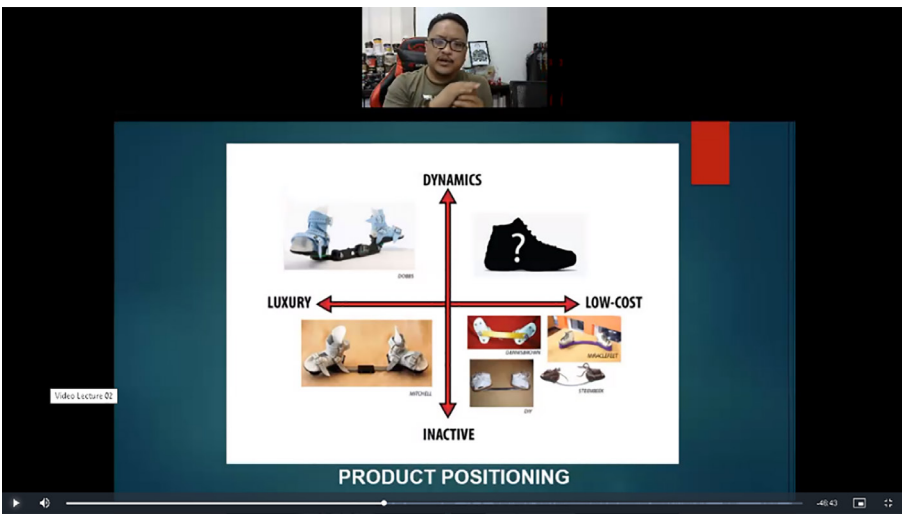

Figure 8. Pre-recorded lectures

The Challenges and Initiatives of Teaching Studio-Based Product Design Subject using Online Platform

Hosting a discussion, design consultation and design presentation online using real-time video platform such Webex, Google Meet, Skype and Zoom, according to the respondents, is enormously challenging due to a minimal interactive contact and improper sketches communication. This is consistent with the findings of Ibrahim et al. (2021) who found that visual communication was the most prevalent drawback of online studio-based subjects and was less successful than in-studio environments. As a consequence, it is difficult for the lecturers and students to achieve a simple and reliable understanding on design knowledge and development. Therefore, some of the respondents use the drawing tablet to do real-time or pre-records sketch demonstration, which helps to enhance understanding of design knowledge and development between the lectures and students (see Figure 9). Through pre-records, students could see them on-demand and re-watch them as many times as they wanted, which was not feasible with live demonstrations. However, faculty and students both required more time to adjust to such approach.

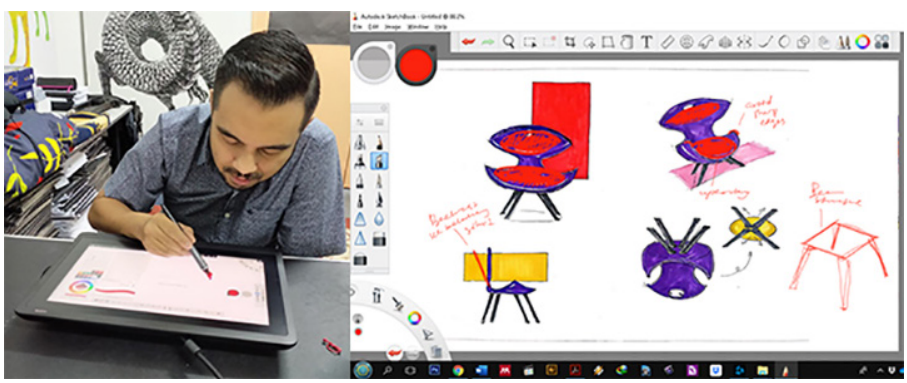

Figure 9. Online design consultation (real-time digital sketching activity) using drawing tablet

The Challenges and Initiatives of Teaching Computer Aided Industrial Design (CAID) Subjects Using Online Platform

Based on interview analysis, most of the respondents used real-time video platform such Webex, Google Meet, Skype and Zoom to deliver lectures and technical demonstration for CAID subjects. Students will follow the technical demonstration and watch the recorded session again, using shared screen and recording features in the real-time video platform. Each assignment in the form of softcopy and digital can be submitted online using platform provided by the universities. However, most of the respondent experience difficulties in coping with technical problem faced by students online. During a normal computer labs session, the technical problem faced by students can be resolved much easier due to the face-to-face interactions where respondents were able to consult and attend the problem promptly on student's workstation. During online mode, however, the situation is

different where the ability to solve the technical problem is incredibly challenging. This is in accordance with study conducted by Yu and Da Silva (2021), which found that advising and attending to technical digital concerns from afar requires good communication assistance. Nevertheless, each student generally confronted with a different technical problem that would take more time to solve one at a time, which may interrupt the class. Therefore, some of the respondents use TeamViewer software to consult and attend to the issue remotely (see Figure 10). For each student with a technical problem, the respondent may arrange appointment and attend them whenever possible.

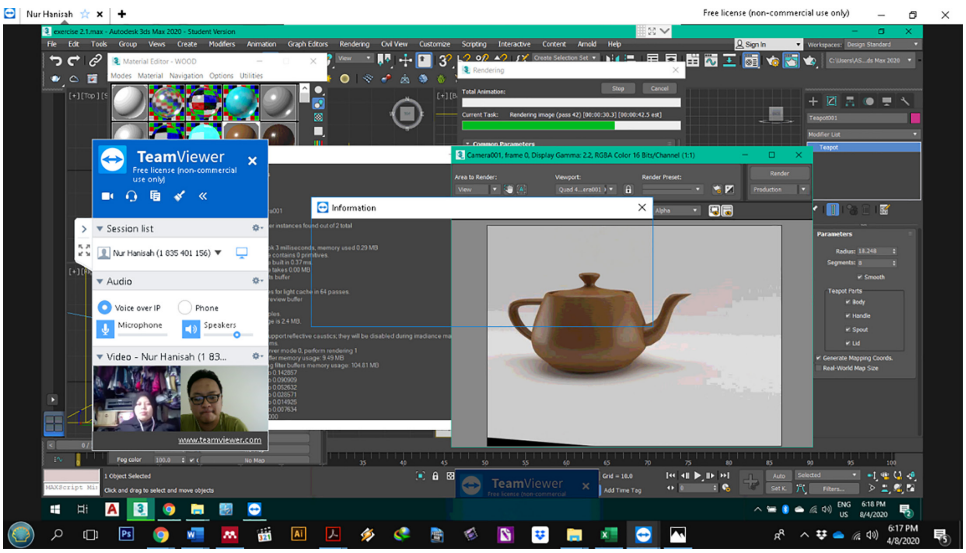

Figure 10. Attending to technical digital concerns of CAID subject online using TeamViewer

The Challenges of Teaching Model-Making

Model-making is a significant element for the outcome of studio-based design task/project. Before the COVID-19's situation, students should spend lot of time doing model-making at the workshop of the faculties where lecturers or technicians will often consult and technically guide them face-to-face. During COVID-19's situation, however, the situation is different in which students were not permitted to be in the faculty and the workshop of the faculties is close to them. Thanks to a video collection of model-making procedures (see Figure 11) provided by the respondents. students may receive concise and content-rich teaching instructions on-demand through their mobile devices. According to a research conducted by Gill et al. (2020), the video collection may illustrate specific operations, be categorised by material, give best practices, and propose materials, mechanisms, and manufacturing methods that might be employed in model-making. Moreover, students were also allowed to present a digital 3D model as a design result to replace a tangible model or prototype (Figure 12). The 3D model evaluation was carried out using 3D real-

time technologies, such as Virtual Reality (VR) and Augmented Reality (AR). On top of that, some of the respondents encourage their students to create the tangible model using 3D printer technology. The 3D printed outcomes were then evaluated using online video platform (Figure 13).

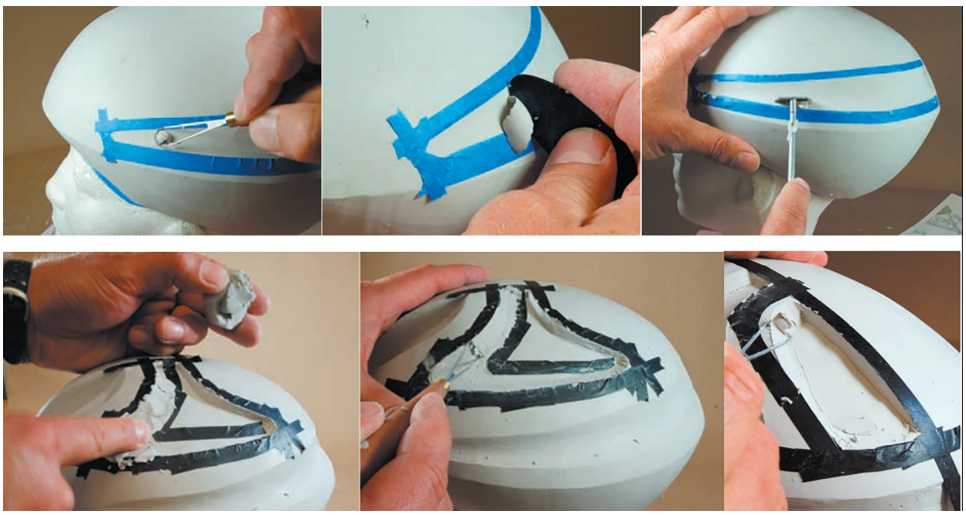

Figure 11. Video of model-making procedures (adapted from Hallgrimsson, 2012)

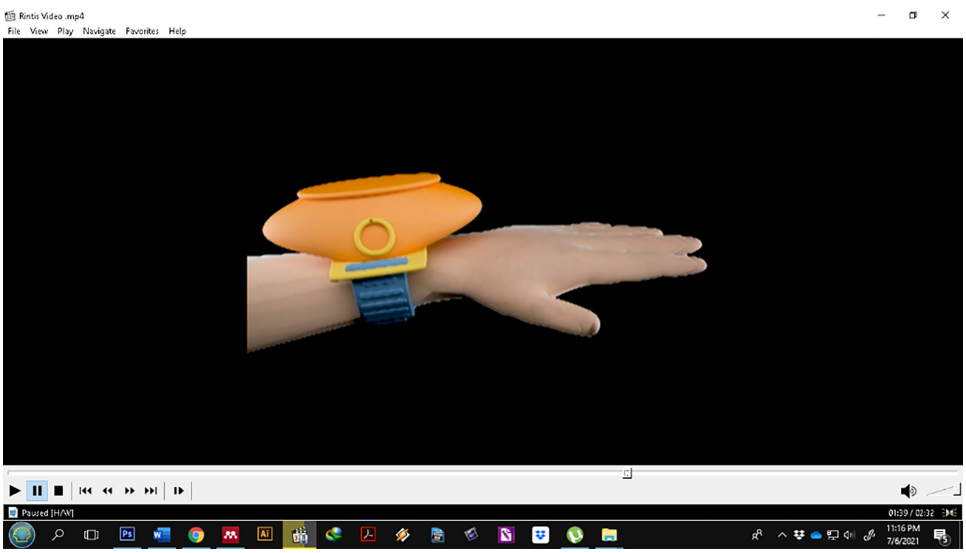

Figure 12. 3D model presentation as a design result to replace a tangible model or prototype

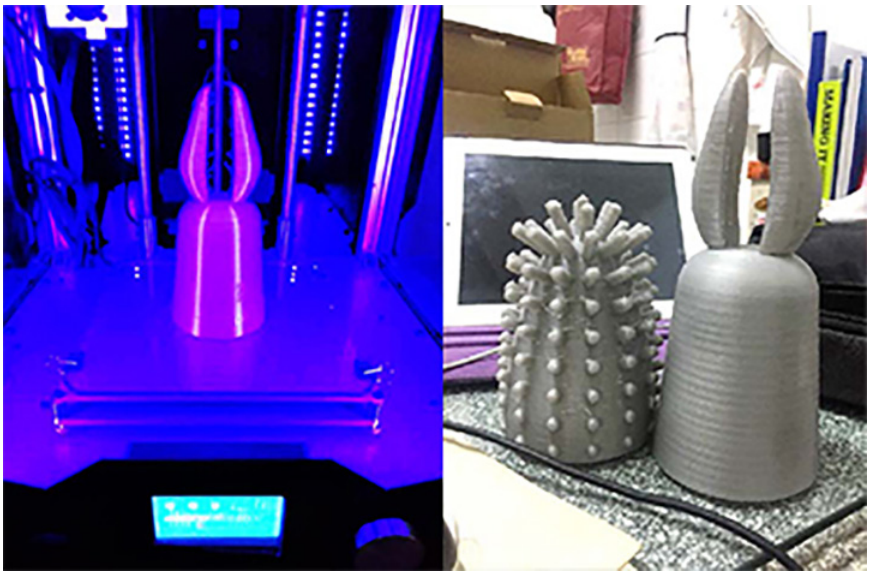

Figure 13. Tangible model or prototype using 3D printer technology

CONCLUSION

Based on the findings and discussions, the aims of this study have been met; to understand the challenges and impacts of teaching and learning Product Design's course online during lockdown due to pandemic COVID-19 in Malaysia including few initiatives taken by product design's lecturers to overcome the situations. In general, it can be concluded that it was incredibly challenging to teach product design's courses online where more delicate interactions are required to ensure the efficiencies of teaching and learning, design outcome, and assessment approach to achieve the learning outcomes. Specifically, when teaching theory-based product design subjects, a numerous real-time video platform was used, but the lack of interaction has caused a distraction, lowering students' commitment and attendance, thus compromised the effectiveness of learning and teaching. Hence, pre-records lecture become the chosen initiative among the lecturers, but online quiz is needed after the pre-records lecture being distributed to ensure students' understanding of the lectures. Nevertheless, a systematic online attendant registry is needed to solve the attendance issues. Meanwhile, due to a lack of interactive interaction, improper sketch coordination during design consultation, and the difficulties in addressing technological challenges encountered by students, conducting an online conversation and design consultation using a real-time video platform during studio-based product design and CAID subjects was also daunting. This causes confusion among lecturers and students about the design project development progress and causing the session to be disrupted. To address the challenge, a drawing tablet was used as an effort to communicate the visual digitally, a prerecorded video was prepared for demonstration, and a software for remote

access to students' computers was utilised to fix troubleshooting issues. Furthermore, since students were not permitted to be in the faculty during the lockdown, students could present their design model using 3D real-time technologies. They were also allowed to use the available prototyping technologies to build the design model or prototype. The implication of the study is hoped to point a range of challenges in teaching Product Design courses online due to pandemic COVID-19 in Malaysia, including the need for more delicate interactions to maintain efficiency in teaching and learning design courses. Moreover, the study contributes to providing a good insight into assessment techniques to accomplish design learning and design results.

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