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Reimagining the Role of Technology in Architectural Education

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Abstract. *Technology is certainly a ubiquitous tool in most, if not all, fields of education. It has undeniably changed our world dramatically, considering the ceaseless innovative developments in various fields of industry. Without technology, a lot of things that people are enjoying in the present would be tedious, most particularly in the areas of communication, transportation, construction, and education where technology is indeed of high significance.*

This study was aimed at determining the role of technology in architectural education using a qualitative research design, specifically interpretative phenomenological analysis (IPA). The respondents were chosen using a purposeful sampling method. Ten (10) educators teaching architecture participated in the study. It primarily investigated the lived experiences of the respondents as they use technology in teaching various architectural courses, hence the following areas of interest were delved into for further analysis: (1) How technology helps in performing architectural tasks; (2) the skills the respondents gain in using technology; (3) the limitations of technology; and (4) the most beneficial technological tools they use in teaching.

The data obtained from the in-depth interview and google survey form extracts were transcribed, coded and thoroughly analyzed using IPA. Data were validated through reflective journaling, member checking, triangulation, and audit trail. The analysis generated three master themes such as "Promoting Precision," "Providing Proficiency," and Enhancing Skills." Each master theme was formed through corresponding superordinate themes.

KEYWORDS*:* technology; interpretative phenomenological analysis; architectural education; qualitative study

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I. Introduction

It is beyond doubt that technology has changed our world dramatically, taking into account the ceaseless innovative developments in various fields of industry. Without technology, a lot of what people are enjoying in the present would be tedious, most particularly in the areas of communication, transportation, construction, and education where technology is used significantly.

In the field of education, technology has been widely used, especially nowadays that most, if not all, countries have mandated their educational agencies to implement virtual studying due to the current COVID-19 pandemic. Nevertheless, many had already opted to study online rather than attending on campus classes even before the pandemic adversely affected the world. This trend could have been brought by the convenience and comfort virtual studying may offer since students could study anywhere, and in most cases, anytime (Ilker, 2020; Aslanian, et al, 2019; Vickers, 2017).

With regard to the inevitable use of technology, technology can bring myriad benefits, and revolutionary changes to the teaching and learning process, hence, most architectural classrooms are filled with technology. Apparently, in the discipline of architecture, technology has radically influenced many architects in terms of designing and obtaining building projects.

Over the years, architecture and technology have intersected to provide major improvements in design quality, helping many buildings become more useful and interesting. Some advanced technological tools architects use include but not limited to BIM (building information modeling), AR (augmented reality), and VR (virtual reality), which could greatly affect architectural profession, the way building is designed, and the position it takes within the field of construction (Foges, 2020).

Historically, the traditional method of performing such tasks was through paper, basic materials (wood, metal, plastic) etc. which was deemed to be subjective to time and attributed skill. In contrast, nowadays we see 3D printing being used for prototyping, and CAD software being used for visualizing and understanding, which have significantly changed the overall idea of conceptual and critical visualization.

Furthermore, the digital representation techniques have replaced the traditional method majorly, which caused a tremendous impact on the architectural education and pedagogies. In recent years, many traditional laboratories have been progressively transformed into experimentation laboratories that are dominated by computers and other electronic gadgets such as tablets and iPads. Due to these rapid changes, the co-existence of different architectural education aspects becomes a main characteristic, thereby cementing the need for students and teachers to be on the same technical page.

Nevertheless, when moving into a technologically advanced curriculum, there would somehow be lingering problems that might occur. The introduction of CAD does reduce time and errors of architects, but situations such as failed save, viruses, compatibility issues etc. can create hindrances and obstacles in the learning curve. For example, software provides file updates, but does not provide a rollback of the files, i.e., a 2013 software file version can be opened in a new version of the same software, but the opposite cannot be done in most cases. The fact that technology is changing will also require the departments employing such innovative pedagogies to consistently update themselves with the new ones so that they won't fall back. Software and devices can be expensive, hard to procure, tough to understand and handle, fragile etc. This would require a separate fraction of people who specialize in minimizing the faults caused by such reforms.

In general, architectural education in Saudi Arabia is influenced by post-modern architecture, traditional history and regional climate. In Dar Al Uloom University, the College of Architecture and Digital Design is designed to create an environment that is conducive to a multidisciplinary, hands-on approach to learning, creative and digital design, and students are educated to meet the highest standards in the market. Since its foundation in 2008, the department has been well-equipped with the latest technologies such as, but not limited to Building Information Modeling (BIM), Computer-Aided Design and Geographical Information Systems (GIS), and model-making laboratories that foster students' drive to desire excellence.

The main objective of this research is to understand the impact of technology in architectural education. It also studies the current technologies used in the fields of architecture and how they benefit the architectural curriculum. Aiming to further highlight the impact 3D drafting has in understanding fundamental design concepts, this work specifically focuses on the examination of architectural education process of the Dar Ul Uloom University, Riyadh, Saudi Arabia, as a case study on which the professors of the Architecture department were interviewed and given survey forms.

II. Historical Background

Technology and architecture are found to be disciplines of collaborative partnerships. In fact, there are various digital phenomena that can have a direct effect in the architectural field such as miniaturization, ubiquity, real-time, noospherization, virtuality and anamnesis. Due to this, many professionals opt to take advantage of the new opportunities beyond the bounds of traditional architectural practice. Furthermore, students of today's generation are considered technologized who are savvier in digital tools and environments, and they start to create changes in both education and the profession from the bottom up (Azizinezhad&Amini, 2011).

Likewise, technology is an integral part of education since the primary role of computer-aided education is to enrich the learning skills of students and foster the teaching efficiency and effectiveness of educators with the help of technology. Furthermore, technology is essential in developing appealing courses for virtual learning. In architectural education, using computers, information technology and equipment is fundamental to develop interesting and understandable demonstrations of various basic tasks and projects in the field of architectural education (Duney, 2015).

In the past, architect sketchbooks used to be bulky and graphite-covered, consequently consuming large amounts of space in an office. Whereas, nowadays, sketchbooks are computer-generated and all outputs can be easily managed without a smudge of graphite touching anything. Consequently, this process helps architects show their clients a sketch much easier and share their ideas to their colleagues much simpler (Geilman, 2018).

Similarly, in a fast-paced and increasingly complex building industry, architects use digital design tools to save time, manage costs, and create more complex and stunning buildings. Some software tools like Autodesk's Computer-aided design (CAD) and drafting software can significantly reduce design time by 41 per cent and improve productivity by 69 per cent (O'Donoghue, 2017).

Furthermore, scholars found out that technology in architecture such as CAD excels in its ability to visualize conceptually specifically with their photorealistic features. Documentation is easier and features such as undo, hide, easier zoom and panning through plans make it an important aspect of speed in architectural design. But it is found that the ability to manually sketch or create models help greatly in the conceptual phase (Ibrahim &Rahimian, 2010).

Likewise, various studies indicated that effective 3D design has a significant impact on the execution of a project such as elimination of field interference, increased productivity and less rework, lesser information requests, decrease in completion time, lesser change orders, and lesser cost growth (Staub-French &Khanzode,

2007). Also, the use of digital technology in architecture helps the construction industry move to a more sustainable building development. Digital architectural design can help improve the expression, creativity, efficiency, and quality of architecture, and it can be utilized to incorporate sustainability into construction projects (Xiang, Yang, Chen, Tang & Hu, 2020).

Overall, we see that technology in architecture helps in visualizing and interpreting design abstracts and concepts. This is because clarifying, understanding, and portraying architecture is better done in all three dimensions rather than in two. The study does not belittle manual drafting techniques but proposes innovative and efficient ways that can bring out the most from an architect. Technology in architecture is a tool that tremendously eases tasks such as learning, visualizing, creating hence making teaching and learning in architecture more comprehensible.

III. Statement of the Problem

This study is aimed at understanding the impact of technology in architectural education, as well as studying the current technologies used in the fields of architecture and how they benefit the architectural curriculum. Using a qualitative design method, Interpretative Phenomenological Analysis (Smith & Osborn, 2008; Pietkiewicz & Smith, 2012) was employed. The main research question was therefore:

"What is the role of technology in architectural education?"

Related to this main research question, the following areas of interest were explored:

1. How technology helps in performing architectural tasks;
2. The skills the respondents gain in using technology in the architectural education;
3. The limitations of technology in the architectural education;
4. The most beneficial software tools used in the architectural education;

IV. Methodology

4.1. Research Design

In order to properly address the research problem, the methodology used was qualitative approach, and phenomenology as its method. Such approaches are applicable and more beneficial to allow deeper and detailed study of phenomena that could not be easily quantifiable (Nunn, 2009), as in this study of "the role of technology." Moreover, the presented approaches allow for the rise of unanticipated results (Barker, Pistrang& Elliott, 2002, cited in Nunn, 2009). The phenomenological approach was primarily utilized to clarify and identify phenomena through how the respondents perceive them in a given event. It helps give emphasis on the individual's experience, 'bracketing' taken-for-granted assumptions and usual ways of perceiving (Lester, 1999).

4.2. Respondents

The respondents of this study are 10 architect educators from Dar Al Uloom University in Riyadh, Saudi Arabia, who have been using technology in teaching architectural subjects.

4.3. Research Instruments

The following instruments were used in gathering necessary data:

(1) Guided Questions – It includes a set of semi-structured questions used as a guide during the interview process. It was duly validated by at least two experts on the field.

(2) Informed Consent Form – It is a form that clarifies the respondents' rights for participating in the study.

(3) Reflective journal – It includes the description of opinions and views related to the topic being studied, which can help eliminate biases while conducting this study.

(4) Voice recorder –A smart phone was used to keep all the information shared by the respondents during the interview.

4.4. Data Gathering Procedures

Due to the current pandemic, which has caused various limitations, only three respondents were interviewed, while the other seven respondents were asked to answer the guided questions through google forms. Aside from verbally informing the respondents of their rights as participants during the interview, an informed consent was provided to all of them to ensure ethical consideration such as confidentiality and anonymity.

Furthermore, the interview process was made with comfort and convenience such as allowing the respondents to choose their location and time. Even though the respondents were very familiar to surveyor, it still made sure that rapport was also greatly established in order to overcome any concern which could hinder them to a rich description of their experiences (Ryan &Dundon, 2008).

A semi-structured guided question form, which includes open-ended questions that were asked in a flexible and conversational manner, while seeking to capture the essence of the questions, was used (Patton, 1990, cited in Cherwien, 2012). All three interview sessions were recorded using a smartphone. Nevertheless, due to various reasons, particularly related to the current pandemic, the other seven respondents were asked to answer the same questions used in the interview through the google forms. They were however called for some clarifications. After that, verbatim transcriptions of the interviews were made.

4.5. Data Analysis

Smith & Osborn (2008) provided the stages of data analysis using the Interpretative Phenomenological Analysis (IPA). The first one was to look for the themes in the first case wherein the transcribed verbatim from the interviews and google forms were read a number of times and took notes of the relevant responses of the respondents. The relevant information was highlighted, and the right side of the transcript was used to indicate the emergent theme.

The second process was to connect the themes wherein the initial themes were listed in chronological order, and determined connections and relevance among generated themes. Also, the initial emergent themes were analyzed for the creation of master and superordinate themes.

The third process was to continue the analysis with other cases wherein the similarities and differences were determined from the chronological list of themes drawn out from all the respondents' transcribed answers. The transcript of a single respondent was treated as a case study in its own right and incorporated all other responses after then.

Finally, the last process was to make a write-up of the respondents' lived experiences, particularly on what they think was the role of technology in the architectural education, wherein they were interpreted using the master and superordinate themes drawn out from the analysis.

V. Results

The analysis of the gathered data from the transcripts of the ten respondents using Interpretative Phenomenological Analysis (IPA) generated ten (10) superordinate themes, which were categorized into three master themes. These are the following:

- *"It improves the accuracy of the design":* Promoting Precision
- *"Helps me work better"*: Providing Efficiency
- *"It enhances my visions"*: Enhancing Skills

Table 1. Master Themes and their related Superordinate Themes

Master Themes	Superordinate Themes
"It improves the accuracy of the design": PROMOTING PRECISION	Promotes Accuracy
	Improves Product Quality
"Helps me work better": PROVIDING EFFICIENCY	Heightens Speed
	Provides Comfort
"It enhances my visions": ENHANCING SKILLS	Enhances Efficacy
	Enhances the Use of Traditional Method

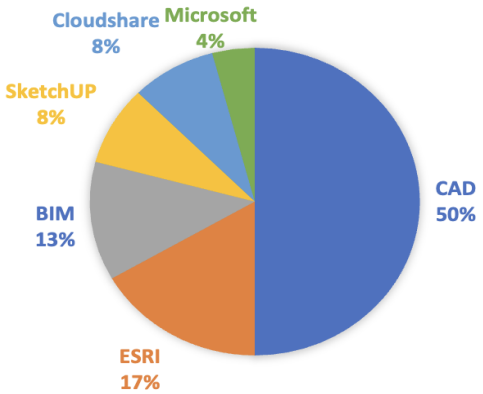

Figure 1. Beneficial Software Tools Used by the Respondents

5.1. Promoting Precision

This main theme captures the ideas that the respondents believe that technology can promote accuracy and help improve product quality. In general, the respondents expressed thatdigital methods can bring more accuracy to their product as they help them easily modify their output and present their class well.

Petera (2009) emphasized that accuracy in architecture is essential because making mistakes in this field can seriously inconvenience the consumer, can turn out to be expensive and even in some cases, dangerous. Nevertheless, technology can help promote precision since it may help offer a third dimension, which is usually neglected in traditional methods, and make theoretical and abstract concepts at the same time.

Geilman (2018) also indicated that materials such as sketchbooks that are computer-generated and all outputs can be managed easily without a smudge of graphite touching anything, which consequently helps architects show their clients a sketch much easier and share their ideas to their colleagues much simpler.

5.2. Providing Efficiency

This main theme captures the ideas that the respondents believe that technology can heighten speed and promote comfort. The respondents particularly uttered that it helps one save time as it makes work faster, easier and more comfortable.

O' Donoghue (2017) cited that software tools like Autodesk's Computer-aided design (CAD) and drafting software can significantly save time. Moreover, Ibrahim and Rahimian (2010) indicated that technology helps in making documentation easier since it has features like undo, hide, easier zoom and panning through plans and it is considered an important aspect of speed in architectural design.

Likewise Staub-French &Khanzode (2007) cited some advantages which promote efficiency with the use of effective 3D design such as elimination of field interference, increased productivity and less rework, lesser information requests, decrease in completion time, lesser change orders, and lesser cost growth.

5.3. Enhancing Skills

This main theme captures the ideas that the respondents believe that technology can enhance one's self efficacy and enrich the use of traditional methods. Overall, the respondents expressed that digital methods can help boost one's self-confidence, provide additional skill and knowledge, and support the use of traditional methods.

Duney (2015) cited that technology is an integral part of education since the primary role of computer-aided education is to enrich the learning skills of students and foster the teaching efficiency and effectiveness of educators with the help of technology. Furthermore, technology is essential in developing appealing courses for virtual learning. In architectural education, using computers, information technology and equipment is fundamental to develop interesting and understandable demonstrations of various basic tasks and projects in the field of architectural education.

Moreover, Soliman, Taha, & El Sayad, 2019; Kalay, (2008) indicated that architecture is a "technology-intensive discipline" since it uses technology in the process of designing and its products. However, Yildirim & Yavuz (2012) argued that despite the intensive use of digital methods in the architectural education and field, it is apparent that traditional or conventional tools are still used, and that digital tools are just supplementary tools to the conventional ones.

Nevertheless, Xiang, Yang, Chen, Tang & Hu, (2020) indicated that the use of digital technology in architecture helps the construction industry move to a more sustainable building development, and that it can help improve the expression, creativity, efficiency, and quality of architecture.

5.4. Beneficial Software Tools

Majority of the software tools the respondents found beneficial are CAD such as 3D, ArchiCAD, AutoCAD and Revit. Nevertheless, GIS such as ESRI ArcMAP and ArcView, and BIM came in the second and third most used software tools by the respondents, respectively.

VI. Conclusion

The main themes with their respective superordinate themes show that technology is an essential tool which can provide various benefits to architectural education including promoting accuracy, improving product quality, saving time, making work easier, more comfortable and faster, enhancing one's skill and knowledge, and enriching the use of traditional methods. In addition, this study found out that CAD, ESRI and BIM software are the most used digital tools in architectural education.

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