

# The Role of Digital Architecture in Students' Design Best Practices

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## ABSTRACT

Architecture students learn to develop, to design 2D or 3D spaces as a facility of human activities. They should create the form of building(s) based on the needs/functions, the strength of the building structure, and the beauty of its appearance. This paper discussed the role of digitalization in the architecture study process based on the author's many years of self-experience as instructors at different studio levels at some architecture schools and observation of the architecture student's learning experience from the basic towards the advanced level of study. As conclusions, first, digitalization in architecture is a supporting part to realizing and visualizing architects' freedom of creativity. Its role is more as a tool than a design stream in architecture. Second, the architectural design process, which starts from individual freehand sketches of ideas, will remain. The digitalization of this process will limit creativity. Thirdly, architecture students and architects should spend more time familiarizing themselves to accept the influence of digital technology in the design process.

**Keywords:** *Freedom of creativity, Digital technology, Studio design practices.*

## 1. INTRODUCTION

Design is a creative activity allowing the design and implementation of a project that is the trace (drawing) of the transformative action that brought it into being and the translation of the scheme of ideas (the design) that has led to its materialization. This activity, considered by several researchers as a complex process [1], brings together a diversity of actors with different nationalities and interests, all working together to define and carry out a project [2,3]. Some typical digital/computer applications or software are already well-known by architecture students in the university. The digital approach is even already introduced in high schools. Therefore, using the digital process in architecture design helps speed up the drawing process.

There are stages of digital process intervention in the architecture design, which are more apparent now. They are the digitalization in idea and concept development, the drawing process, finding architectural forms, and the intervention in architectural design research [4]. In the advanced stage, application and software are essential to study and do simulations related to sustainable design, green design simulation, evidence-based design, and

reconstruction of ancient buildings to learn the particular ancient civilization in a period.

The digitalization of architecture design in the undergraduate program of universities primarily focuses on the student's ability to produce and present their ideas using the computer, for example, from completing the design programming report, creating 2D and 3D drawings, and delivering the design in front of the jury at the end of study semester. However, in a master of architectural design program, graduate students should be able to use research software to support evidence-based, sustainable, or green designs.

## 2. LITERATURE REVIEW

The evolution of digitalization in architecture teaching and learning has taken a decisive turn with the appearance of digital tools dedicated to designing, representing, modeling, or communicating an architectural project [4]. Initially adopted from the aeronautical, manufacturing, automobile, shipbuilding, aviation, and animation industries, these tools and techniques rapidly increased within the architectural design from the late 1980s onwards [5], forever transforming how architects design and realize projects.

Indeed, digital technology, as a reality that imposes itself in all fields and particularly in architecture, has profoundly modified the different modes of production, interaction, and exchange within an architectural project. The possibilities of sharing, representing, or communicating, which now offer to the architect, bring him to a whole new dimension with powerful network effects and opportunities to process data on a large scale. This digital revolution reorganized the chain of value. It imposed new models that the designer must seize to optimize and apprehend the opportunities of such an evolution to apply and adapt them while designing and implementing the project [6]. Beyond a simple aid to represent the ideas for the designer differently, the digital document brings the project, more and more, towards new dimensions that modify in-depth the core definition of usual keywords such as representation, modeling, or communicating throughout a design process [7].

This evolution carried out by digital technologies also had a considerable impact on the educational and teaching framework. It has implied for educators the need to initiate themselves to new approaches and new didactic means that lead them to address the teaching of architecture differently via digital environments. On the one hand, it allows multiple interactive, augmented, or immersive possibilities, and on the other hand, possibilities of co-design and sharing to happen [6]. Furthermore, it is a teaching that brings the architecture student towards a new way of designing, modeling, communicating, and perceiving their project. Design education then meets the multiple teaching and learning challenges requiring us to question, explore and simulate different modes to incorporate and take advantage of these digital devices and software.

### 3. RESULTS AND DISCUSSION

The discussion focused on the architectural design process generally taught in the architecture schools and mentioned in some design process textbooks announced to the students. It is stage-by-stage works students should do to complete the design studio assignment supported by the activities and the equipment usually available in the school. Students should do exercises like producing sketches and scaled drawings, creating scaled models, doing computer simulations, or rendering and presenting the basic ideas until the final design product in scheduled jury review sessions.

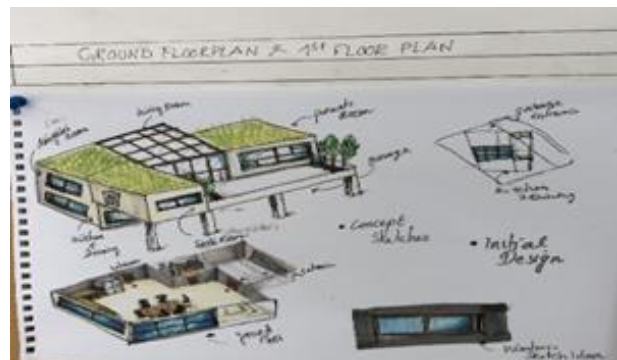
#### 3.1. Freehand Sketching

Freehand sketching is usually one of the introductory courses at the beginning of architecture study. Students train themselves to be able to visualize their ideas using sketches on paper. In the first year, they learn to produce freehand drawings and may

continue to use the computer in the design process in the upper years. Nowadays, there is already a compromise between freehand sketches and computer software or drawing applications in a design process [8].

The use of digital software can be divided into three stages, first the freehand sketches as the first step in realizing the main ideas/creativity of architects toward the design based on the idea as an innovative process undertaken by the architect himself. Second is the stage where architects develop their 3D and study models using digital / software tools. The third is the last stage; some tools finalize the design drawings, models, and design drawings.

To design and distribute the digital courses in our program, we started with an inventory of tasks, which in pedagogy are recognized as essential skills to be acquired by students to analyze, imagine, design, and build an architectural project. We established a benchmark for each of these tasks to identify when they appear in Anglo-Saxon schools of architecture [9]. We have developed three groups, the first group involving representation, the second group involving collaboration/coordination, and the last group involving data manipulation. Our digital approach is on an everyday basis introducing the AutoCAD/SketchUp couple from the first semester and then diversifying the practice by introducing BIM software (Revit) and finally Dynamo as an elective course in the architectural curriculum. See figure 1 below.



**Figure 1** Student's freehand sketches during the beginning of a design process [10].

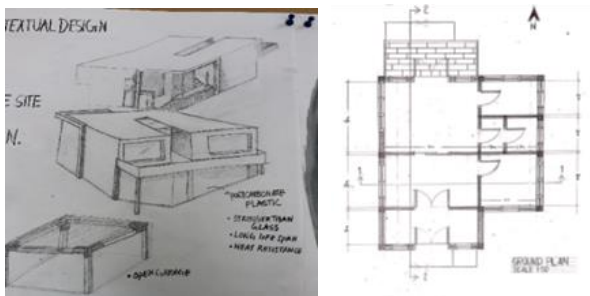
#### 3.2. The Course Learning Outcomes (CLO) in the Design Studio Course Syllabus

The design studio syllabus's course learning outcomes (CLO) are essential for the architecture study program. They are the expected goals in each studio design course students take. The CLOs indicate students' learning results in the studio at the end of the semester. Below are examples of course learning outcomes from the first until the fourth study year [9]:

### 3.2.1. First-year Design Studio

- To analyze design concepts related to the three-dimensional world, function, space, volume, and mass.
- To present visualized design ideas using sketching, drafting, and modeling techniques.

The first course, "ARCH115: Architectural Drawing and Presentation," introduces students to the most common 2D and 3D software (AutoCAD and SketchUp) used in architecture to create and develop graphical and technical presentations. Emphasis was on giving the students tools to digitize sketches, drawings, and concepts to examine design ideas in terms of accuracy and workability of schematic design. See figure 2 bellow.

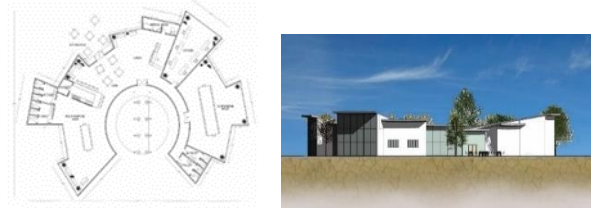


**Figure 2** Examples of freehand sketches and manual drawings of a simple building façade and a floor plan [11].

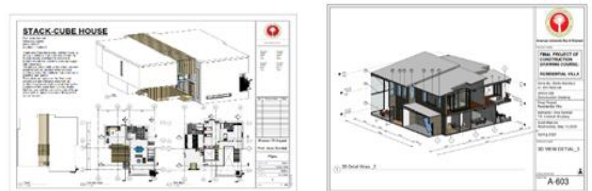
### 3.2.2. Second-year Design Studio

- To complete and present the entire architecture drawing based on drawing convention. To design and compose a group of simple buildings under particular building function, city context, local climate, and people characters.
- To begin to work using CAD drawing tools.
- To experience to present their architectural design process and product verbally.

Building on the skills and knowledge acquired in the first course, the second digital course ARCH223 "Computer Architectural Drawing," offers the students the possibilities to explore a Building Information Modelling's (BIM) software (Autodesk® Revit Architecture) and to reinforce their visual, technical and digital representation skills and techniques. The emphasis in this second digital course is given to modeling and rendering 2D and 3D interiors and exteriors, furnishings, accessories, and details for architectural design projects. See figure 3-5 bellow.



**Figure 3** Digital drawing of a floor plan and building façade [12].



**Figure 4** Technical drawing examples [13].



### EXTERIOR SHOTS

**Figure 5** Students' effort to implement the parametric approach in the design process [14].

### 3.2.3. Fourth-year and Fifth-year Design Studio

- To understand how design can minimize the impact of buildings and urban areas on the broader environment.
- To have the ability to use simple energy simulation software to evaluate design options. It is the implementation of the design skills and architecture knowledge using digital software or application to enhance the design quality.

## 3.3. The Experience

### 3.3.1. Programming Process

This stage is the beginning of the architectural design process, where students should collect important information about the needed facility. Parallel to the information gathering, students should creatively draw their design concept related to the function of the building. This stage will produce a room-program list, diagrams, sketches of building forms, and a brief explanation of the project. In this stage, students like to use freehand drawings to explain what they think about the project. It is an innovation, imagination, and translation process of the ideas on paper. It is the first insight of students to get forms in their mind and

visualize them directly on the paper in the form of schematic sketches.

### 3.3.2. Sketches and Drawing Production

This stage is a continuation of the first stage. Students have to present their idea and the appearance of the building they want to design. Communication of ideas uses drawings as the visualization to raise comments, feedback, and suggestions from other people. Furthermore, the completion of the design idea will use digital tools because it can speed up the process.

Some students can present excellent impressive drawings because of their ability to use applications and software for presentation drawings. Some students still like to use freehand sketches and computer drawing tools in this stage. However, they need time to be able to use the tools in the studio. It is time when students start to use computer hardware such as private laptops or personal computers available in the computer lab.

### 3.3.3. Simulations and Research Software

This stage is where the students try to develop or create scientific supports for the architectural design they are working. This stage is the scientific part of the architecture design to answer evidence-based design needs, green design, or sustainable design. The simulations or research usually use the available software in the computer lab because they are from another study program like building physics, building structure or, mechanical engineering. In addition, the computer can enhance design quality by improving the students' ability to understand concepts, such as light, texture, and shape.

Nowadays, many simulations or research software are available that are primarily user-friendly, especially to architecture students. But in daily use, the students need extra time to learn them before using them in their design. These types of software are more familiar to the postgraduate students who continue their study to master or Ph.D. level.

### 3.3.4. Time-scheduling

This aspect relates to a common weakness in finalizing students' design assessments in the studio. More students now rely on digital drawing tools instead of finishing their designs manually. They know that using digital drawing software will speed up the drawing process. Knowing this situation, some students put more time into their design creation process than drawing production. As a result, they tend to prolong the creation process until the last minutes of the submission schedule. Some others still try to modify their building

form or appearance without considering the time limitation.

Based on this habit, students can miss some actual drawings required in the assignment and only focus on other requirements they can produce. They tend to make more unscalable perspective drawings rather than the complete floor plans, final building elevations, building sections, or some essential construction details they should have.

### 3.4. Other Supporting Aspects

The last part of the discussion is the fast development's influence of digital technology: job market demand and investment in the equipment for the school. The beginning of the 21st century is the booming period of the digital technology development of software and hardware to support the architectural design process. More private laptops, personal computers, and drawing software are available. Architecture students have more options to choose their drawing tools, but on another side, they should have proper financial support to follow this development. Updated versions of the software are primarily available in a short time which makes the previous version looks out of date relatively fast.

Furthermore, the hardware/computer supporting equipment development is also fast following the software development. Therefore, the story of the internet, e-cloud, and big-data technology in a laptop directly affects the performance of the hardware, which is part of the big world industries. To the architecture schools, the cost may be an essential issue for computer software (the price of devices, software, training, maintenance, and periodical development). This situation can significantly change the work systems in the design units. In addition, there is more demand in the property industry on human resources who can work with computers. This demand will continue to happen along with the digital and internet technology and facilities development. Therefore, the request to be able to work using BIM will become stronger.

## 4. CONCLUSION

The digital tools in architecture nowadays are standard as supporting part in the study in the university or the job market. The fast development of digital technology and IT influences any aspect of our daily life, including architecture design. Below are some conclusions based on the discussion of the author's experience;

- The first design stage is more successful through freehand sketches that need innovation, imagination, and ideas to the papers than computer applications. The schools should maintain this.

- When introduced to the digitalization of the design process, tool or software that provides aid in architectural design should be able to fulfill architecture students' requirements in starting from the first stages of architectural design.
- Students need time to familiarize themselves to work with the tools and software available.
- The financial issue may be essential to the school to utilize computer software (the price of devices, software, training, maintenance, and periodical development). In addition, the utilization of computers can significantly change the work systems in the design units.

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