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# INVESTIGATING THE ROLE OF DIGITAL SKETCHING IN CONCEPTUALIZING MARITIME STRUCTURES AND ARCHITECTURAL FORMS

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**Abstract**
Architectural designers concentrate on the first phases of the design procedure, namely conceptual design.The primary objective of this phase is to identify a resolution for a current issue, examine the design space, or analyze a concept.This phase often starts with drawings to investigate ideas and solutions; the inherent ambiguity and imprecision of traditional freehand sketching foster creativity.Currently, advancements in digital technology are prompting efforts to incorporate technological devices into conceptual design to establish a digital design medium inside the field of architecture.Recent advancements in Computer Aided Design (CAD) software indicate a transition towards a conceptual design interface; however, these tools remain underdeveloped and inadequately provide an appropriate setting for sketching. Using digital tools in the initial design phases has engendered problems and obstacles concerning creativity.The issue is why digital sketching has not yet replaced traditional freehand drawing.This research concentrates on the initial stages of the design procedure, aiming to examine the present state of digital sketching, along with its associated debates and obstacles in architectural design learning. It investigates the present-day sketching tools utilized in architecture and the inclination of instructors and students to employ digital sketching in practical applications.This study addresses the current advancements in Structural Health Monitoring (SHM) techniques for offshore and aquatic buildings.The majority of SHM methodologies have been created for terrestrial facilities.Limited research exists about the use of SHM technology in offshore and aquatic buildings.This research addresses this deficiency and emphasizes the difficulties ofimplementing SHM approaches in offshore and marine constructions.This study employs a qualitative methodology, using an online survey for data collection.Research indicates efforts to examine and develop interfaces and software to improve electronic systems or innovateinteraction methods to foster creativity and drawing.Studies suggest that academics remain skeptical of digital tools; there is a propensity among instructors and learners to use these technologies provided they fulfill educational requirements.
**Keywords –Digital Sketching, Maritime, Architecture,Structure**

## 1. INTRODUCTION
## 2.

Current offshore and marine constructions are intended to have a finite lifespan [1].Failures over their operational lifespan result in severe ecological and economic repercussions and deadly incidents.Over 60% of the existing offshore and underwater buildings on the Norwegian continental shelf, the United Kingdom mainland shelf, and the Sea of Mexico shelf have surpassed their intended design life.Over the last twenty years, Structural Health Management (SHM) has emerged as a significant area of study within civil engineering [10].This innovation amalgamates many engineering disciplines, including sensor technology, materials research, artificial intelligence, data science, data mining, and structural design[2].A primary objective of SHM is to avert early failure and guarantee optimal structure functioning.
The implementation of a SHM system necessitates three main parts: (a) the formulation of the method's overarching strategy, gathering data and administration techniques, and workflow design; (b) the execution of the strategy, configuration of instruments, and establishment of models; (c) the processing of data, extraction of features, comprehension, and appearance.Based on structural complexity, costs, and the significance of the building or its elements, a SHM system is developed to achieve one of four distinct levels: (a) damage assessment,

(b) damage location verification, (c) damage severity assessment, and (d) life expectancy estimations[4]. SHM tools are essential for quality control of high-profile structural elements to ensure safe service delivery[6].
With the advancement of computer technology, numerous software applications have been created, used for writing, layout, simulations, evaluation, and factories to visualize in three dimensions, mimic performance factors, and manage and coordinate production data [3]. Digital technology influences the designer's cognitive processes, facilitating a transition from creating and visualization to design generation and optimization; however, traditional digital software inadequately supports the initial conceptual design phase[8].
When machines are infrequently utilized in the preliminary design stage, numerous architects resort to paper and pencil and model making to articulate their plans and ideas [15]. In architectural educational institutions, manyof those studying architecture commence their initial design experiences predominantly through machines[9].The limited willingness of academics to use this kind of equipment has resulted in the absence of courses entirely reliant on technological advances in teaching.
This article examines the position of digital drawing in the first stages of designing, the prevailing obstacles in education, particularly with imagination, andwhy computers are not yet widely used in the initial stages of building design[11].By examining and analyzing contemporary digital drawing tools, efforts are made to ascertain suggestions for developing digital interfaces that facilitate the sketching and creative creation of designs[12].

## 2. BACKGROUND
## 3.

Sketching is often linked to initial design concepts, and there are continuous endeavors to explore how machines assist in this phase of the creation process; scientists are focused on creating Sketch-Based Interactions Modeling (SBIM) [5].
The concept of sketch-based modelling is not novel.It originates from Sutherland's sketchpad method.The user uses a light pencil to create 2D drawings by directly scribbling on an electronic display screen.Over the past ten years, there has been a significant proliferation of sketch-based displays and pen-based computers[14].The various eras of SBIM areattributed to distinct gadgets that influenced their creation and development: the light pencil, the digitizing tablets and stylus combo, the computer mouse, and, more recently, multi-touch devices and pen-based applications[16].The evolution of early design instruments has depended chiefly on drawing input, emulating the conventional architectural milieu, streamlining system communication, and facilitating diverse design elements.

### 2.1. Pen-based drawing systems

Most architects depend on traditional pen and paper media [13].Due to the inability of mouse-based media for computers to facilitate the functions of pen and paper during early sketches, several researchers have shifted their focus to the study and creation of pen-based systems.In 2D pen-based structures, a stylus is used on the display rather than a pencil on parchment.The only distinction is in the design surroundings[18].The program was executed on a tablet equipped with a pen input gadget, including a uniform pen-based interface that emulates pencil and paper drawing, while using computer aid to improve and supplement the method.With the advent of stylus-operated touch-screen tablets and unaided sketch programs, this system aims to enhance the Computer Aided Design (CAD) [7] by offering amenities and functionalities such as rapid visualization of designers' ideas, ambiguity conclusion, gesture recognition, and conceptualization.This new technical tool does not jeopardize conventional drawing; it assists designers in conceptualizing throughout the creation phase.Bill Gates unveiled the Windows Tablet, which includes a touch display and interoperability with desktop computers.The introduction of the Apple iPad in early 2015 offered a gadget that connected the laptop computers and smartphone, delivering unparalleled user mobility and freedom. A computer employs a stylus to replace the pen and screen instead of paper.

### 2.2. Three-Dimensional Digital Modelling

Digital technologies have introduced three-dimensional modeling as a significant feature and facility in the first phases of design [17].Studies indicate the significance of integrating 3D modeling into the early architecture design process to provide distinctive design ideas.In this instance, visual creative thinking is executed using three-dimensional digital representations that might be characterized as spatial drawing.From a design perspective, 3D modeling often focuses on the first design stages to analyze and visualize intricate details or larger structures.Utilizing user-friendly software for 3D modeling facilitates the identification of suitable design options.Utilizing user-friendly software for 3D modeling facilitates the identification of suitable design options.
3D modeling enables students to enhance their comprehension of their designs and significantly improves their design skills quickly. This digital representation has a strong visual effect and allows architects to simultaneously contemplate items, space, and form on the same display.However, contemporary challenges arise in 3D digital simulation, since it presents novel opportunities for form modification while necessitating diminished cognitive engagement. Specific 3D shapes are elementary to create in CAD but challenging to depict in a manual

viewpoint.This led pupils to assume that rare depictions equate to creativity.This is why electronic models are considered dangerous during the first design stages.

## 3. PROPOSED DIGITAL SKETCHING IN MARITIME STRUCTURES AND ARCHITECTURAL FORMS

The suggested technique for assessing current buildings is fundamental to gathering data from a sound structure using computer modeling.The proposed method is founded on establishing a correlation among environmental variables, such as loads or materials deterioration, and structural behavior.This link elucidates how the structure responds to varying ecological variables.Mathematical modeling, including Finite Element (FE) modeling or analytical methods, is used to ascertain the structural reaction.
The data set necessary for training a substitute model includes inputs and results.Inputs include elements from environmental circumstances, including wave and wind characteristics, geometrical variations, and degradation rates.Results include the structural reaction, such as displacements or stresses, or the damage stage, contingent upon the specific SHM technology being implemented.Fig.1 illustrates the procedure for creating a surrogate simulation.The values for input (environmental circumstances) areascertained from actual tangible information or the projected spectrum.Upon completion of the training procedure, the substitute model can forecast the output using the data collected on the surroundings.The presence of inputs and results in the training database facilitates the supervised learning procedure.

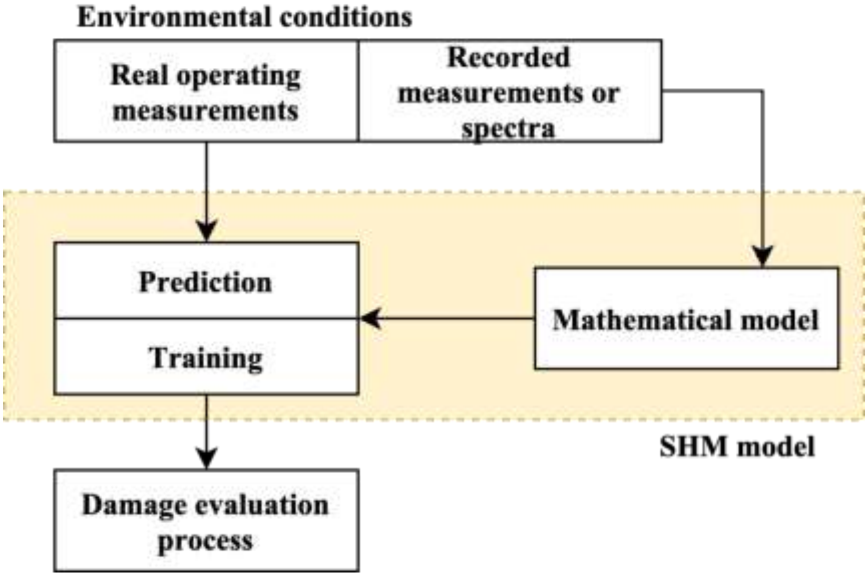


Fig. 1. Workflow of the model

3.1 Findings

A total of 190 surveys were distributed, with just 65 responses received.Thirty-six percent of responses were from Turkish colleges and universities, while sixty-four percent were from other nations.The gender distribution of teachers who replied to the questionnaire was 71.40 percent men and 29.5 percent women. Their educational and academic domains predominantly encompass architecture and schooling, design principles, electronic and computational layout, virtual design production facilities, Building Information Modeling (BIM), and creative design. Most instruct junior, senior, and graduate pupils, with just a limited number offering courses to freshmen and sophomore pupils.
The survey, along with general inquiries, comprised three parts. The initial part required instructors to respond to four inquiries regarding their and pupils' design instruments. The initial query inquired about the drawing media that teachers utilized at the design's onset. The following question addressed the sketching instruments employed by their pupils. The third query examined the design instruments teachers chose for their students, while the final query investigated the drawing tools deemed successful for pupils.Every query has four design approaches that responders are required to evaluate.
The second component of the survey has 16 statements that participants must evaluate based on their level of agreement or disagreement (Fig. 2).Professors and learners in creative studios utilize programmes.Results indicate that conventional freehand drawing in four tests achieved the highest positive scores and recorded no negative results.Direct engagement with CAD applications has a few benefits.

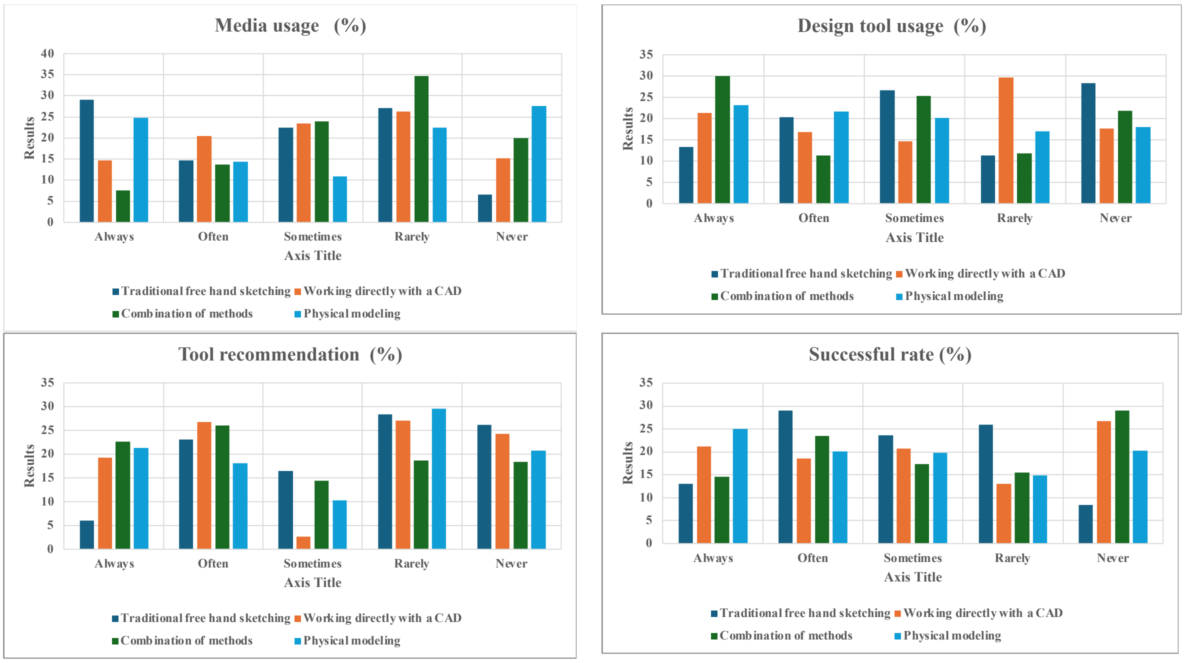


Fig. 2. Survey results

The replies of all respondents were assessed using the Likert analysis approach.This scale technique assigns values from 5 to 1 consecutively on a 5-point ordinal scale (ranging from usually to never).The values for every layout and drawing process were computed.The results indicate that the "conventional free-hand drawing" tool, with a 100% use rating, is the predominant designing tool among educators and pupils, while "working right away in a CAD software" had the lowest favorable response at 50%. Integrating freehand drawing with CAD systems has equivalent merit to the actual modeling approach, exhibiting an 85% positive inclination compared to a 15% negative inclination.

## 4. TECHNOLOGICAL OBSTACLES AND PROSPECTS
## 5.

In reviewing the literature on the issue of SHM for offshore and underwater structures, scientists have suggested several methodologies.Methods for assessing the safety of structures include both traditional and innovative techniques.Obstacles persist in the SHM of offshore and maritime buildings.

4.1 Obstacles

The challenges in developing and sustaining offshore and marine structures stem not from the buildings but from the environments in which they function.Natural stresses, like wind and waves, are markedly non-linear, uncertain, and unexpected, presenting difficulties in assessing fatigue life.Moreover, floating items encounter buoyancy forces, complicating the forecasting of their responses and evaluating their structural safety.Interaction between saltwater and dynamic objects, corrosive conditions, and plant development provides complex load and response forecasting challenges.SHM in the coastal and marine sectors encounters uncertainty from their operational settings.

4.2 Research Deficiencies

The suggested methodology for establishing SHM has significant potential for advancement and enhancement.Recent articles on traditional SHM indicate that investigators utilized numerical simulations in commercial applications, which are notably time-intensive and expensive.Formulating analytical solutions rather than numerical representations swiftly approximates a system's reaction due to advancements in software capable of managing complex mathematical computations.Analytical techniques can offer extensive sets of information for the development of pattern recognition systems.

Data collected from sensors on buildings in offshore locations, accounting for the aforementioned uncertainty and difficulties, is likely to include essential information.The analysis and interpretation of the data require the creation of innovative systems that are adept at managing it.Innovations in processing signals and machine learning methods areexpanded to provide vibration-based SHM in maritime and offshore constructions.Techniques suggested for using ambient vibrations (low-amplitude) apply to coastal and underwater structures owing to their low-amplitude, high-cycle vibrations.Delineating (fatigue) damage indices establishes non-parametric damage identification for the present purpose.

## 5. CONCLUSION

This research examines the present state of digital drawing in the first design phase and its issues in the educational sector, particularly regarding creativity.Findings from studies suggest that novel interfaces for computers started to influence designers' cognitive processes within the first phases of design, prompting extensive discourse and problems within architecture studies and instruction.Recent advancements in digital tools indicate a transition towards conceptual design interfaces; yet, their use in the first design phases remains limited.This pertains, firstly, to the user connection of electronic devices that promote accuracy and detail, precluding inconsistency and uncertainty, which is crucial in design concepts. Secondly, the utilization of digital structures does not align with the rapid cognitive processes of designers, in contrast to traditional freehand drawing.The capacity of people to use this technology should not be overlooked.

A review of techniques suggested for the SHM of coastal and underwater buildings has been conducted.Two traditional methodologies, the method based on models and the vibration-based strategy, were evaluated.Research indicates that digital technologies facilitate and augment creativity, notwithstanding these factors.They foster creative behaviors and encourage the exploration of a broad spectrum of design choices by re-evaluating and enhancing prior concepts.Several studies endeavor to provide advice for improving digital systems or developing novel methodologies for their utilization to foster creativity and drawing. A study indicates that to create an interface that mimics conventional drawing and encourages creativity, the structure must effectively address confusion, allowing architects to concentrate on design challenges rather than software use.The advent of specific pen-based sketching structures has fostered a significant inclination, particularly among younger designers, to utilize them during the conceptual design stages. However, the limitations of this software in promoting ambiguity and imagination have led many seasoned designers and scholars to question its efficacy or even reject its use in the creative thinking procedure.

The findings of the pilot investigation in the field of education corroborate ongoing discourse in the research arena and theoretical insights, indicating that academics exhibit skepticism towards digital tools, preferring a hybrid approach of freehand drawing with CAD applications instead of direct use.The data suggest a propensity for instructors and their pupils to use these technologies.Advancements in digital programme user interfaces are anticipated to facilitate their usage as designing and conceptual tools in future generations' first phases of architecture education.Collaboration among architecture, mathematics, and computational science answers these issues effectively.

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