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Revitalizing material interpretations: augmenting learning in online architectural education through material embodiment and communication Revitalizando las interpretaciones materiales: aprendizaje aumentado en educación arquitectónica online mediante materialidad y comunicación

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FITNAT CIMŞIT KOŞ
Gebze Technical University, Turkey
cimsitkos@gtu.edu.tr

SEBEN AŞKIN KÜTÜKÇÜ
Gebze Technical University, Turkey
s.askin@gtu.edu.tr

ECE ÇINAR BALCI
Istanbul Technical University, Turkey
cinarec@itu.edu.tr

ABSTRACT Material augmentation and communication techniques in online education enhance architectural thinking and creation, opening new avenues for design exploration. By focusing on responsive constructions and unconventional modeling techniques, this study fosters a more immersive and expressive design approach. The methodology unfolds in three phases: local mapping based on environmental experiences, exploration of alternative material deviations, and the development of new tectonic principles through material representation. These phases critically examine the interaction between modeling techniques and material variations, aligning reality with representative preferences. The primary aim is to challenge conventional architectural modeling through dynamic processes and material perception strategies. Ultimately, the study offers alternative processes centered on materials and communication tools, enriching the educational experience by promoting deeper sensory and intellectual connections with the built environment for future architects.

RESUMEN Mejorar el pensamiento y la creación arquitectónica mediante la ampliación de materiales y técnicas de comunicación en la educación en línea abre nuevas posibilidades de diseño. Este estudio se centra en construcciones responsivas y modelado no convencional, fomentando un enfoque más inmersivo. La metodología incluye tres fases: mapeo local con experiencias ambientales, exploración de desviaciones materiales y desarrollo de nuevos principios tectónicos. Estas fases analizan la interacción entre técnicas de modelado y variaciones materiales, alineando la realidad con las preferencias representativas. El objetivo es desafiar modelos arquitectónicos tradicionales con procesos dinámicos y estrategias de percepción material. Finalmente, se proponen procesos alternativos centrados en materiales y herramientas de comunicación, enriqueciendo la experiencia educativa al fortalecer las conexiones sensoriales e intelectuales con el entorno construido.

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KEYWORDS material embodiment, augmentation, design education, architectural modeling, revitalizing communication

PALABRAS CLAVE materialización, aumento, enseñanza del diseño, modelado arquitectónico, revitalización de la comunicación

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1. Introduction

This study explores alternative material design parameters in first-year design studios, emphasizing interactive and material augmentation in responsive constructions through innovative modeling techniques for enhanced communication. Alternative material design parameters refer to strategies and approaches that redefine material integration and interaction, particularly through unconventional sensory and technological modeling methods. These parameters challenge traditional material applications, fostering dynamic and flexible design solutions that incorporate novel material properties and sensory experiences beyond conventional design frameworks. It addresses the following questions:

(1) How can alternative material design parameters enhance architectural thinking and making, and what innovative methods support this?

(2) How do material augmentation and communication techniques foster a more immersive and expressive architectural design approach, enabling deeper connections with architectural theory?

The study was conducted during the period when education was held online due to the COVID-19 pandemic. To achieve its aims, three methodological layers were developed based on the 14-week online studio process to connect optical and digital gazes within alternative material design: local mapping with environmental experiences, exploration modeling with alternative material deviations, and the creation of new tectonic principles through material representatives. All layers of this study strive to engage in an alternative performance that enables a responsive construction to establish a meaningful connection with the surrounding environment. This process encompasses various elements, including blurred contextual ambiguities, material variations, dynamic representations, and embodied experiences. These actions can be described as vibrant, evolving, and responsive.

Within this framework, students are encouraged to explore diverse bodily experiences by delving into the intricate relationships that exist within seemingly inert actions in their respective environments. The parameters governing these relationships are investigated through the limitless possibilities offered by selected materials in architectural modeling. This modeling technique represents an avenue for alternative expressions and anticipatory lines of exploration, all conveyed through a screen, while evoking a sense of touch. In this context, it can be stated that the unconventional forms of architectural model making serve as a sensitive aspect of space and evoke diverse perceptions. To regulate and structure these trajectories, alternative processes built on constructive materials and comprehensive strategies are required. These strategies are responsive and adaptive, going beyond mere representation to possess a self-representative quality. The concept of comprehensive thinking encompasses both representation and materiality in conjunction with a corresponding connection. Material awareness and communication tools introduce a novel avenue for specialization based on these connections. These representations are deeply integrated and provide references to alternative elements within the virtual studio experience. By engaging in the modeling process, students generate unpredictable and synchronous scenarios, where all potential reactions contribute to a deeper understanding of the actions undertaken.

Author(s)	Year	Key Concept	Relevant Quote/Idea
Deleuze	1987	Smoothness & Transformation	"Continuous variation and continuous development of form" define smooth space.
Deleuze and Guattari	1988	Diagram as Abstract Machine	The diagram does not represent reality but constructs a new reality yet to come.
Tschumi	1994	Cinematic Representation	Cinematic frames and sequences challenge traditional architectural representation.
Lynn	1999	Digital Materiality & Time-Based Design	Computational properties (topology, time, parameters) redefine architectural modeling
Merleau-Ponty	2002	Embodied Perception	The body can extend perceptual experience, much like how a car becomes part of a driver's body.
McCann	2005	Information Technology & Embodiment	"The principal danger of information technology is its seductive tendency to stand in for embodied experience."
Aureli and Mastrigli	2006	Temporal Complexity in Representation	Contemporary representation evolves through dense, fluctuating stagnation.
Volk and Marcus	2009	Performance and Performativity	Representation delays meaning; architecture shifts from form/symbol to forces and performance.
Vidler	2011	Diagram as Dynamic System	Diagrams interpenetrate and generate new configurations of matter and functions.
Grillner	2012	Temporal Contextuality	"I now understand, from season to season, over the years to come, depending on my relational ties and its various uses."
Thomsen	2019	Active Materiality	"Materials are not passive and this is embodied in craft knowledge."
Lozano-Hemmer	2019	Material Quality of Thought	"Experience first emerges as a material quality or thought-sign… virtual events, occurring in the gaps of experience, are real and bodily despite being unfelt."
Lewitt	2020	Information vs. Emotion	The rise of the information society reduces space for emotional understanding
Hettithanthri and Hansen	2022	Enhancing Collaboration and Creativity in Online Design Studios	Online contexts show signs of escalation in collaboration due to the networking ability generated through digital communication tools.
Maani and Roberts	2023	Design Studio as a Distinctive Pedagogical Setting	A design studio fosters a unique learning environment where students co-create knowledge, question norms, refine their work, share skills and apply learning beyond the studio.

Table 1: Summary of Literature on Material Experience and Representational Interfaces in Alternative Modelling Approaches. (2025)

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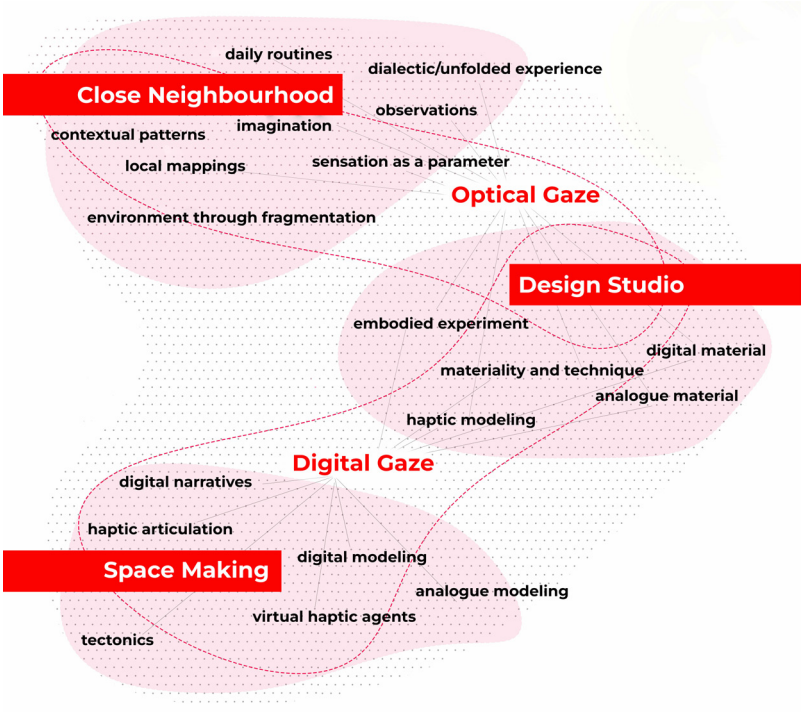

Figure 1: Theoretical Framework & Online Studio Process. (2025)

2. Theoretical framework

The Theoretical framework of the study is based on alternatives about material experience through an embodied experience in the case of living representation in online architectural design studios. As Hettithanthri & Hansen (2022) mentioned, conventional design studio context minimizes the potential of getting exposed, narrowing down their creative thinking parameters but online contexts, it was evident that the level of collaboration shows signs of escalation due to the networking ability generated through digital communication tools.

This study explores an alternative modelling approach that questions the form-based context of conventional processes. While alternative approaches allow for sensory deviations in materiality, the communication process often reduces these to vectoral augmentations through representational interfaces. But what if material reality were anchored in experience? To address this question, a literature review was conducted and summarised similar concepts (Table 1).

Based on these discourses, the theoretical framework was structured as follows to explore beyond static visibilities and to consider temporalities as material design parameters: Layer 1 (3-week): *In/Inside, Tangible/Intangible Experience*, Layer 2 (5-week): *Multi-Sensory Representations; Between Optical and Digital Gaze*, Layer 3 (6-week): *Embodied Experience and Experimental Materiality*. The theoretical framework of the online studio process is shown in Figure 1. This framework highlights the hybrid nature of contemporary design education, where digital and physical methodologies intersect through a multifaceted approach that integrates sensory perception, material exploration, and digital modeling. It illustrates the conceptual and methodological structure guiding the online design studio process, mapping out interactions between design thinking, perception, and material engagement within the broader context of analogue and digital practices. The framework is structured around three interrelated domains: *Close Neighbourhood*, *Space Making*, and *Design Studio*. Close Neighbourhood emphasizes contextual patterns, local mapping, and sensory perception, focusing on how students engage with their immediate environments. Space Making explores both digital and analogue modeling, haptic articulation, and tectonic processes, integrating virtual and physical design methods. The Design Studio serves

as a central hub where materiality, technique, and haptic modeling converge, bridging optical and digital methodologies. Within this structure, the Optical and Digital Gaze form a conceptual link: the optical gaze relates to traditional visual observation, while the digital gaze encompasses digital narratives, modeling, and haptic articulation. Together, these interconnected layers foster an immersive and responsive design pedagogy.

2.1. Unfolding Context: In/Inside, Tangible/Intangible Experience

Context is not a problem that requires solving; rather, it comprises a range of possibilities embedded in time, awaiting responses within daily routines. Perception, active within the body, transcends rootedness and fosters a generative shift between reality and representation, facilitated by new material tools. Modeling is not merely an optical means of problem-solving; instead, it entails experiencing the process of formation through a dialectic and unfolding journey. Actors within this paradigm are not confined to specific sides or edges; rather, they navigate within an activated environment that encourages responsive articulation. Therefore, modeling is not merely a singular moment of articulation; rather, it embodies a formless and performative artifact. The distinction between material modeling and material reality fades, giving rise to expanded possibilities for both within the framework of daily frames and sequences. As an example, the context mapping sequences of a student project from the studio are shown below (Figure 2).

The most potent contradiction lies between the architecture of form and the architecture of sensations, perceptions, and vital forces in case of understanding the context. The trajectory of innovation gravitates towards a new paradigm—an architecture for living forces. Space, events, and moments are not isolated layers of action; they possess a living essence akin to our nature. The synchronic "living" layering necessitates a progressive approach to modeling, one that represents responsiveness and, in turn, is responsive itself. Regarding the state of living, this study explores the self-performative interface, wherein the concept of representation transforms into a study area that promotes interdisciplinary collaboration and holistic information flow within an alternative design studio process. By navigating this flow, a space can be developed where the sensitive essence of context, events and moments are seamlessly intertwined, a creative layering that reshapes not only the built environment but also fundamental understandings of the nature of design can be opened up for discussion.

2.2. Multi sensory representations in online studio process; material modeling between optical and digital gaze

Conventional design methodologies come under scrutiny due to the diminished interaction between tutors and students in a studio setting. In this context, experiences through transformed models offer a novel way to share the intangible and unseen aspects of design. Intelligentia wisdom assumes that materiality transitions to immateriality, perception becomes visual, tangibility gives way to intangibility, and representation evolves into experimentation. Thus, online design studios should lead a comprehensive exploration of material experiences, virtual processes, and digital representation from a critical perspective. In this paper, the term "material" encapsulates the complex interplay between performance and material performativity within contemporary architectural practice and discourse, showcasing the intricate relations at play.

Through virtual processes, the loss of tangible modeling skills and representatives has been keenly felt, as the desire for physical touch has been impeded. However, local mapping, embodied experimentation and alternative material deviations are known to have been explored in face-to-face architectural studio settings as well. This study argues that tangible experiences can be hybridised in virtual education as well. The virtual as a medium has yet to be considered as an extension of the

Figure 2: An example from the mapping sequences in the online studio (P32). Adapted by the authors based on student work (2025)

body. The alternative material modeling process (Figure 3), where these changes occur, opens up an alternative era for architectural education, deserving further exploration and inquiry. Progressive design process and its representation media has a great impact on time and perception. Material basically means the performative body of the animated nature which is the human body, animal body, routes of animal and human body and inanimate landscape as operational tools.

The transition to operational tools within this "material" can be read through the representation of the context in architectural education. In architectural education or even in the general act itself, an architectural site is conventionally conceived in a dimensional space of idealized location, topography. In that sense an object is defined as a point, line or plane. But in this study each piece is a blur vector whose trajectory is relative to other pieces, forces, fields and flows, and defines form within an active space. All these pieces define a tectonic data which smoothing the differences but incorporates free intensities through possible and unexpected relations. Smooth mixtures are not homogeneous and therefore cannot be reduced. At that point the site is no longer a linear process under defined information. Blur and temporary information breaks the limits of time and creates a contextual experience dependent on individual differences and realities. This conflict on site needs more progressive presentation techniques in design which is no longer form based.

Figure 4 illustrates how modeling reinterprets architectural representation, aligning it more closely with the design's essence and everyday sensory experiences. Unlike traditional reductionist methods, the digital algorithmic modeling approach embraces the unpredictability of daily life, challenging conventional definitions of body, nature and space.

Traditional architectural representations, which solely aim to convey existing information about a site, can limit designers' exploration of new possibilities. Rather than relying solely on limited preexisting knowledge and concrete inputs from the site, representations that incorporate abstract sensory parameters have become a focal point in contemporary architectural discourse. Through these experiential-based representations, all sensory parameters begin to shape the production of space. This approach enables the expression of the layered and fluid nature of experience, revealing its inherent potential during online communication. This shift allows for a transition from static space production practices to the reproduction of spaces based on experiential relationships.

The integration of computability theory positions architecture as an interface, fostering interdisciplinary collaboration with fields like biology, IT, and mathematics. It enables the analysis and reconstruction of information across disciplines through its universal structure, promoting a holistic approach. Emerging design tools and active strategies generate reciprocal perceptions, inseparable from the materiality of space. The boundaries between virtual and analogue realms dissolve, resulting in an overlapping living environment.—The tangible receptivity of the digital medium indicates the perceptual space, allowing for an open and transformative experience. Space, with its layers, represents a reality that can be shaped. Networks of relationships become visible through these layers, unveiling new interconnected possibilities. Layers provide an operational strategy, containing information and fostering potential experiences. This logic is evolutionary, devoid of fixity and imbued with clarity. These perception-based systems are uninhibited, projective, operative, prospective, open, evolutionary, and multilayered. In the simplest terms, they aim to experience, expand, and extend.

This multiplicity is topological, transcending axiomatic or typological constraints. Layers signify the aspects that cannot be perceived solely through sight, highlighting the augmentation of information via both analogue and digital mediums. Through computers, this perceptual augmentation process allows our digital environment to function as a material mind, enhancing our capacity to perceive the world as a heightened reality. As layers contain individual pieces

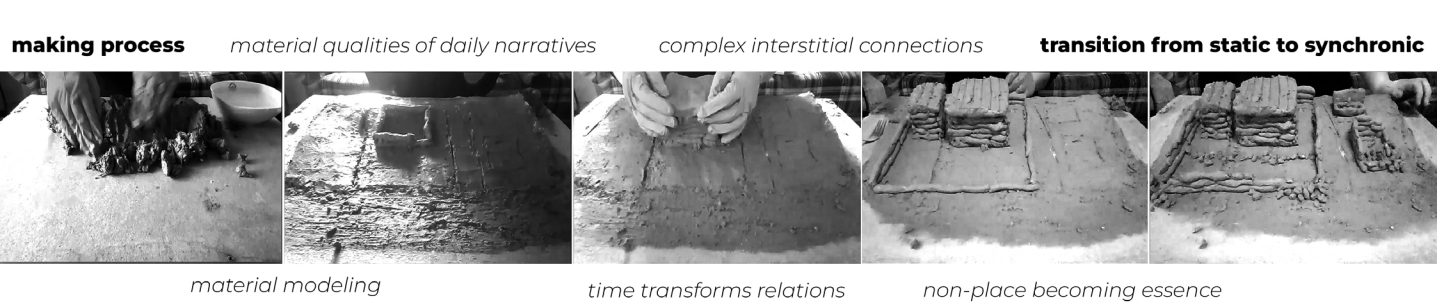

Figure 3: An example from the video sequences of the making process using clay in the online studio (P2). Adapted by the authors based on student work (2025)

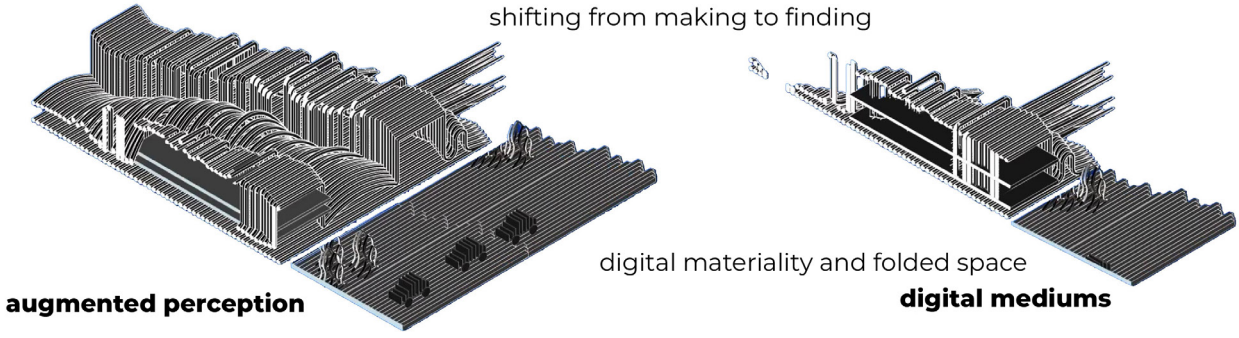

Figure 4: An example from the digital representation process through a Rhino model in the online studio (P3). Adapted by the authors based on student work (2025)

of information, their interplay transforms the system into an environment. This multilayered medium, controlled through digital materiality, points to a folded space that is self-generating and topological, characterized by high perceptual capacities and semantic relations.

In the context of alternative design education, the digital gaze represents the transformative generation of the process, necessitating an urgent shift towards materiality. The overlapping nature of thought and action emphasizes the significance of materiality as the most tangible mode of communication within the material modeling realm. This research explores various modeling methods that define spatial systems while introducing new understandings of design within the architectural discipline, such as the utilization of responsive materials and progressive productions. Tangible and intangible parameters of local mappings act as attractors in connection with alternative materiality.

2.3. Embodied experience and experimental materiality

The visualization of each situation recorded through material modeling creates a notational system that allows for the perception and understanding of the entire process. Consequently, the material qualities of each daily narrative emerge through the modeling process, with each line carrying a significant impact. These intrications represent complex connections that interrelate local surfaces of elements through interstitial rather than internal connections. The heterogeneous elements within a mixture lack inherent relations both within the mixture and among themselves. Furthermore, the external force that intricately connects these elements lies beyond the control or prediction of individual elements. In Figure 5, smooth interfaces are interwoven with multiplying models and various layers of reality, transforming all representation tools into a seamless domain. Through the modeling processes, time transitions linear static relations into synchronic smooth interfaces. This implies that the model is not merely a collection of relations between forces or a specific place but rather a "non-place" that becomes the essence of the place itself.

The key to understanding alternative modeling is distinguishing between making something and using metaphorical, symbolic, cartographic, or diagrammatic languages. As Cimşit Koş and Arıdağ (2017) suggest, a modeling topology can be established that directly engages with the reality of formation rather than imitating it. As a result, architectural creations produced through this approach establish their own reality, emphasizing bodily experiences, unexpected narratives, and the revelation of underlying representational processes in today's representation environment.

One of the motivations behind alternative modeling is to provide an intermediary condition that synchronically layers presence, image, and idea through possibilities. The architectural model is no longer an abstraction of an idea; it represents a reality emerging from the design process, integrating body, time, and daily experiences. Here, the concept of time is not purely historical or chronological but experience-based and cartographic, reflecting its own unique editing. The aim is to uncover the effects of this progressive relationship, established over time, on the design process. Reality is rarely simple; it's the challenges we encounter that give life its vibrancy, complexity, and meaningful echoes. —Nevertheless, advancements in information and technology reshape the concept of time as individuals progressively perceive it. In this context, it becomes apparent that the concept of reality in the architectural design environment, shaped through non-representational dialogues based on students' own embodied experiences, emerges from the space-time encounters between the subject and the object.

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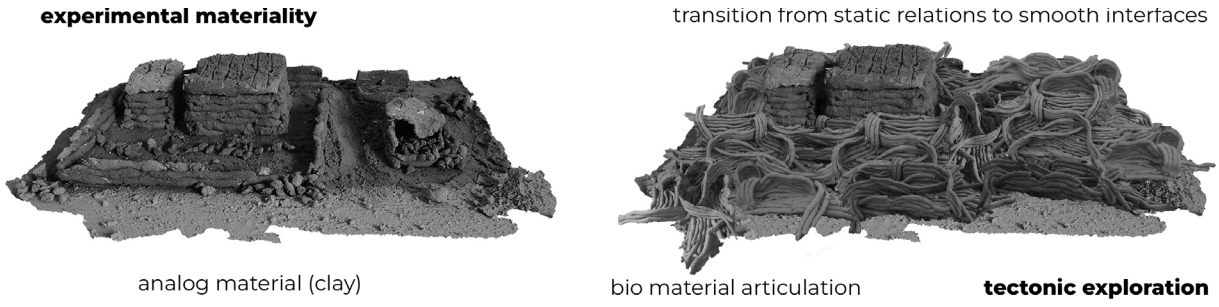

Figure 5: An example from the making phase of the tectonic articulation sequences (P2) Source: Adapted by the authors based on. Adapted by the authors based on student work (2025)

3. Methodology

The methodology employed in this study consists of three experiment layers aimed at addressing the research questions outlined in the introduction. Through the experiences of Studio ACT-N, a First Year Online Design Studio, a total of 32 students were tasked with building a Responsive Reading Nest in a primary school garden in their neighbourhood over a 14-week semester. For a total of 32 students over 14 weeks, video recordings were utilised for the purpose of data collection. Prior to this, the students were tasked with creating multi-layered videos. The objective of this exercise was to ascertain the synchronous relations and to facilitate the creation of an interactive platform. Each student was assigned a virtual workspace via the Teams platform. It is also noteworthy that the submissions were open-source. Material experiments were conducted, and the process videos necessitated the continuation of modelling during the online studio.

The syllabus is structured into four phases, each addressing different layers of spatial and narrative exploration. It begins with the Intangible Reading Stories phase, where students engage in mapping and analyzing the intangible values of reading experiences, uncovering spatial narratives related to storytelling. In the second Archi-Local Cartographies phase, the focus shifts to the tangible and intangible spatial agents within local contexts, with students constructing elements using a unique material to connect their designs to specific environments. The third phase, Tectonic Scape, explores the tectonic indicators of these spatial agents, emphasizing materiality and construction logic in shaping responsive spaces within the final phase which examines bodily experiences within urban contexts, encouraging students to integrate their interventions into broader urban realities, fostering a dialogue between the Reading Nest and the city.

In the "local mapping" layer, the students focused on fragmenting and exploring the everyday details of these school gardens and their surroundings. Despite the distinct names of the schools, it was observed that the primary school gardens in Turkey shared a similar typology, with slight environmental variations. Understanding the environment through fragmentation and the interplay of these details was crucial in perceiving and modeling the relationship between the material modeling and the environment. However, the students' familiarity with these environments allowed them to imagine the lively aspects of these familiar spaces. Auditory representations, such as the sound of the bell, students' voices, or natural sounds, were also incorporated into the maps, complementing the visual data.

These representation methodologies differ from the conventional analysis often employed in online studio processes. Instead of disaggregating the natural and perceived data of the environment, thinking about the environment through fragmentation, confluences, and overlaps played a vital role in the students' perception and modeling of the environment's material relationship. The interaction between animate and inanimate elements surrounding the school gardens, combined with images and illustrations derived from the environment, emphasized sensory experiences. Details such as garden walls, niched places, seasonal changes, prominent trees, mobile toasters, water pots, bird nests, bushes, muddy soil, construction remnants, and resting spots under trees were represented on the map to capture the sensory essence. These parameters, often overlooked in conventional environmental understanding, empowered the students to create responsive designs by immersing themselves in the design process with integrated perception. This perceptual state facilitated an open-ended design knowledge and skill, extending beyond the physical realm through material formation. By establishing a performative process, the study revealed the relationships established in temporalities rather than focusing solely on static appearances.

These experience-based local mappings and material models transcend mere representation of the site. They represent more than physical appearances, allowing for the interpretation of tangible and intangible

fragments of space. They create a new reality that does not rely on any specific real condition but exists as a collection of real, lived fragments. This process, a collective experience using new material tools, enables the exploration of alternative design parameters. The methodology of this study involves three layers: local mapping with environmental experiences, exploration of modeling with alternative material deviations and the development of new tectonic principles and methodologies through material representation.

Each layer is designed to interactively and materially enhance responsive constructions using alternative modeling and representation techniques, thus creating a new mode of communication within the process. The methodology seeks to explore the correlation between modeling techniques and material deviations within the common studio context. The parameters are determined through critical matches between existing reality and representative preferences. The continuity between layers is examined through a matrix, while the final layer initiates a discussion on representation principles in design studios, particularly in relation to collective thinking.

Layer 1 focuses on the movement and perception of the body on the close neighborhood site, highlighting the daily routes and the synchronicity of the environment in connection with the fragments of environmental sensation. This intensive mapping establishes a strong relationship with the city, capturing both tangible and intangible environmental fragments. Layer 2 synchronizes these environmental fragments with materiality, manifesting as material modeling in both digital and analog forms. Layer 3 synthesizes the relationships established across layers, exploring new tectonic principles. The body is considered a valuable component within the content, and an adaptive surface synchronization is developed by constructing new realities. The constructive information, transformed through experimental representation techniques or digital manipulations, is integrated. All layers studied both as a progressive research and design interface.

All components of the layers are grounded in optical or material principles. These layers and their parameters are collectively examined and discussed. The consciously chosen tools, continuities, and superpositions reveal that tangible parameters are common and often align with digital tools and representations. Most students engage with tangible fragments, while intangible fragments, though less common, still appear significantly. Analogue materials are more frequently used than digital materials, with only a few students (P3, P5, P7, P19, P20, P24, P27) incorporating digital materials. Representative articulation is common, particularly among P2, P4, P10, and P13, while experimental articulation is rare, seen only in P10, P14, P17, and P18. Some students (e.g., P2, P10, P12, P13) work across all categories, showing versatility, while others (e.g., P14, P15, P16) focus on fewer methods. Students like P10 and P12 take a multi-modal approach, while others focus on traditional or singular methodologies.

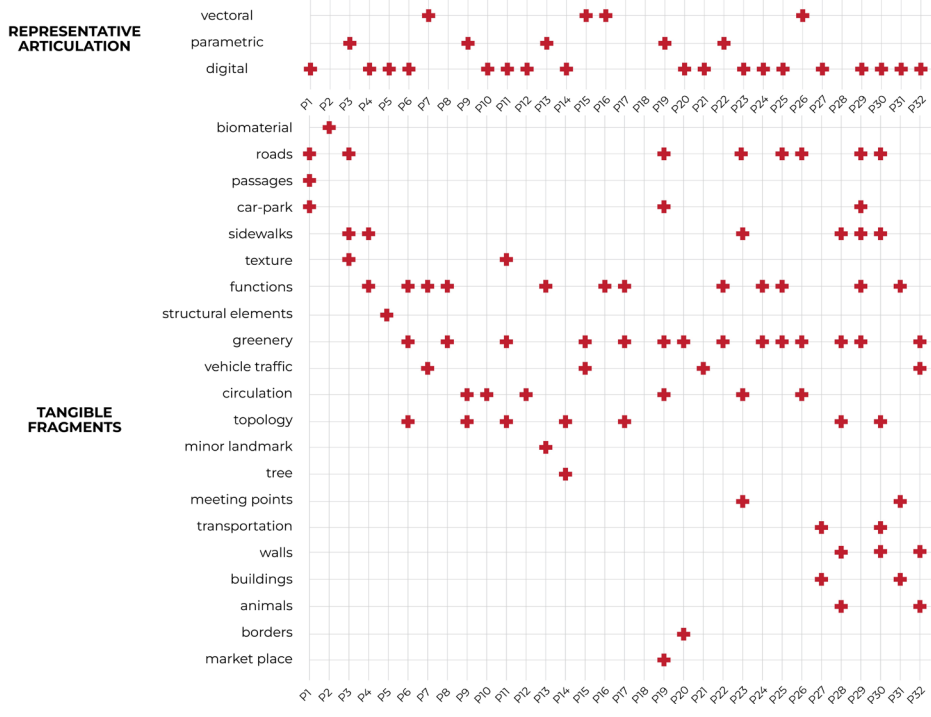

Figure 6: Interpreting the relation between representational articulation and tangible fragments. (2025)

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4. Findings

Modeling serves as the dynamic catalyst in architectural design, allowing information to be visualized with a systematic flow and alternative materiality. This understanding also highlights the significance of design thinking as a cognitive process that carries knowledge and promotes continuous improvement and sustainability through experiential learning. Alternative material projections for architectural modeling and perception strategies are key in exploring alternative approaches to learning. This responsive state of design fosters an open-ended acquisition of design knowledge and skills, expanding beyond the physical realm through material formation. Students can utilize this formation to transcend physical constraints and create models that are not limited by physical boundaries. This process, established performatively, allows for the revelation of temporal relationships rather than focusing solely on the static appearance of materiality. Within the framework of this study, the experience of material modeling was considered cartography, employing various techniques to navigate the relationship between information and space. Abstraction within this cartography is viewed as a presentation challenge, where an active model can generate its own questions, transcending the limitations of presentation. It exists as a trans organism, blurring the boundaries between reality and representation. These models exhibit transitory characteristics in both their agency and relationship to reality. Instead of being confined by the predetermined features of the architectural context, such as existence, location, structure, and function, preferences flow more flexibly and spontaneously. This means that the design process occurs within the fluidity of these preferences rather than being confined to idealized notions. This dynamic activity challenges and redefines the notion of place.

The correlation matrix was created according to the listed qualitative and quantitative parameters of the layers. The coding system was analysed through the lens of process diagrams and the final outcomes of the projects. The Flourish Data Visualization Program was utilized to interrogate all data. The studio matrix highlights the limitations of the process in capturing intangible parameters due to its constrained context. While modeling provides an opportunity to explore new materialities for haptic realities and their experimental

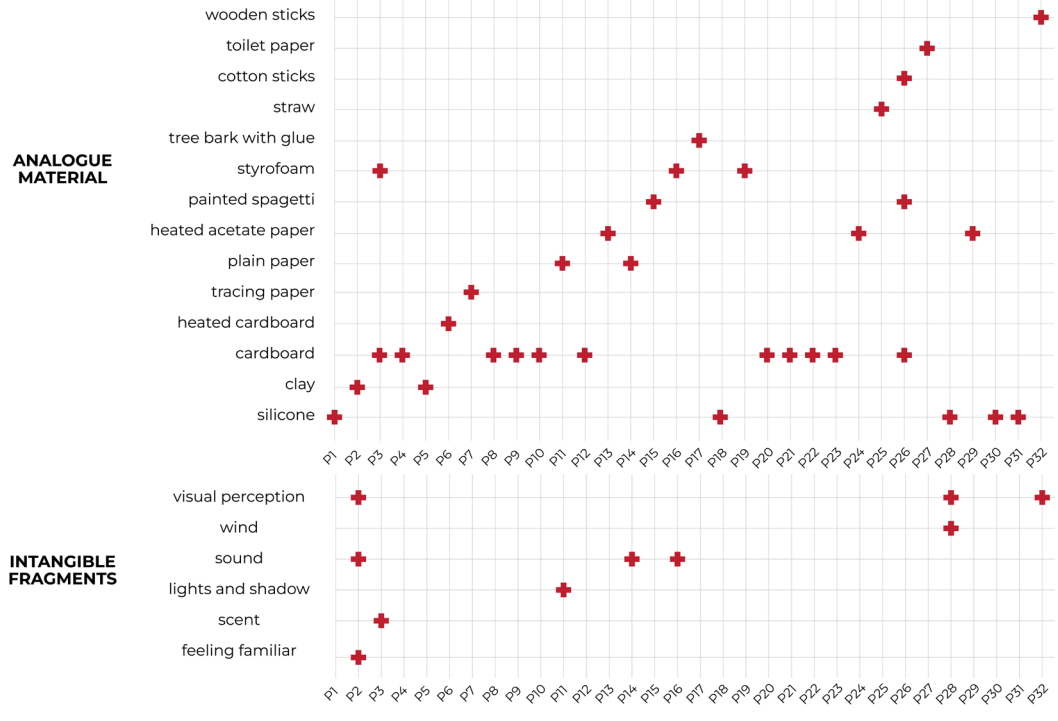


Figure 7: Material Embodiment as a Mediator for Intangible Perception. (2025)

representations, this process of blurring involves considering methods and tools that align with the concept of non-representative agents.

Figure 6 demonstrates a notable alignment between representative articulation—which implies limited experimental engagement—and tangible fragments that are materially evident but sensorially passive. Projects relying on conventional representational techniques (e.g., vectoral, static visuals) predominantly reference urban elements like *sidewalks*, *road textures*, and *basic topographic functions*. These elements are easier to render but less open to interpretive or embodied engagement. In contrast, digital and parametric articulations appear to encourage a more layered exploration of fragments such as *greenery*, *meeting points*, or *walls*, reflecting a shift toward interpretative complexity and multiscalar awareness.

Figure 7 explores how analogue materials—particularly those with texture, fragility, or organic origin—shape the emergence of intangible fragments, such as *sound*, *light*, and *tactile familiarity*. Projects involving unconventional materials like *tree bark*, *painted spaghetti*, or *heated cardboard* correlate with multi-sensory interpretations. This evidences the potential of analogue material plays to unlock embodied and immersive readings of space.

In contrast, the clustering of standard materials (e.g., *cardboard*, *styrofoam*) with the category of *'none'* or only *visual perception* signals limited sensory engagement—often reflecting passive or habitual material use.

When the tangible and intangible dimensions are overlaid, a reinforcing dynamic appears (Figure 8). Projects that cite no intangible components are concentrated around infrastructural or segmented tangible elements—such as *roadways*, *functions*, or *circulation*. These are typically explored through representational rather than experiential means. On the other hand, projects referencing *sound*, *light*, or *wind* often gravitate toward spatial conditions that are ecologically or socially responsive—*walls with greenery*, *meeting places*, or *animal traces*. This mutual alignment suggests that material and representational experimentation opens pathways to deeper spatial sensitivity. Together, these visual analyses support the central argument: in online architectural education, the extent to which students experiment with material articulation—be it digital or analogue—has a direct influence on the perceptual richness of their spatial interpretations. A tendency toward representative methods often coincides with materially and sensorially limited outputs.

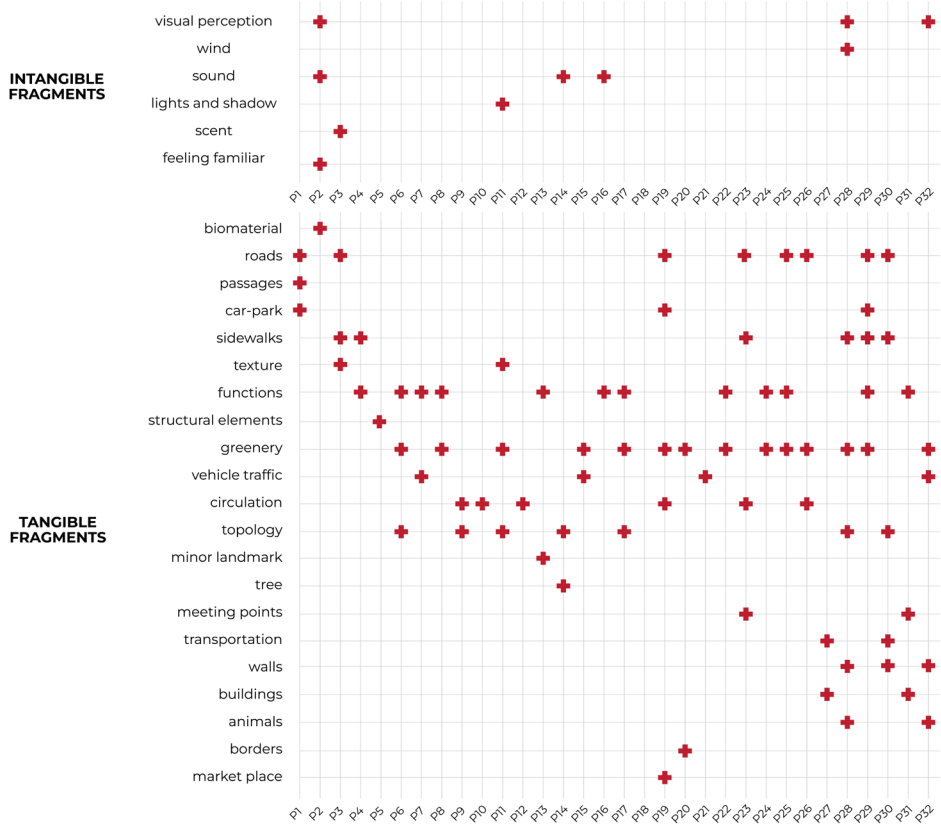


Figure 8: Cross-mapping tangible and intangible fragments. (2025)

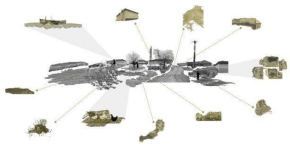
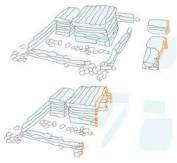
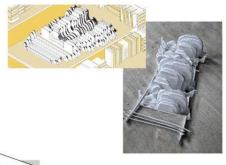
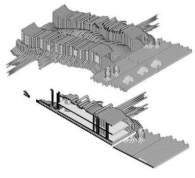
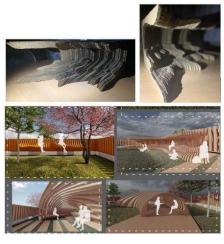
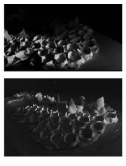
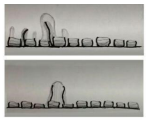
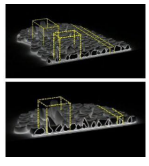
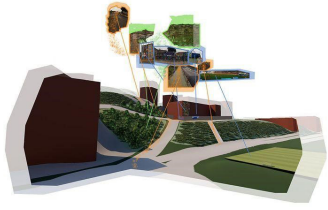
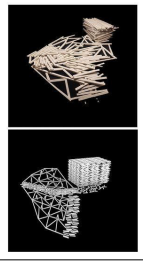
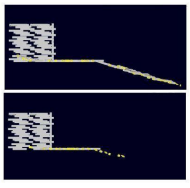
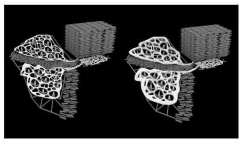
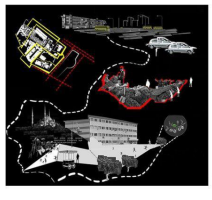
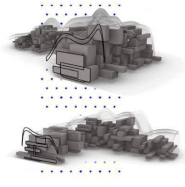
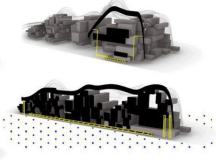
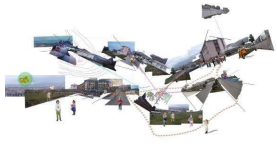
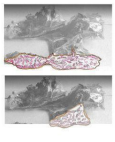
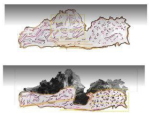
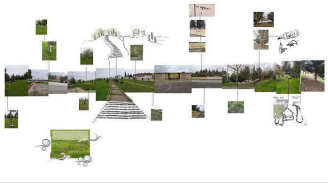
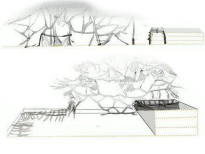
Material Representation		Process				
experimental articulations via material modeling	P2					
experimental and representative articulation	P3					
	P5					
representative articulations	P9					
	P19					
analogue materials and experimental tectonic articulations	P17					
	P28					

Table 2: Examples of material representatives via tangible and intangible fragments. (2025)

Conversely, when students engage with experimental tools and processes, they uncover richer fragmentations—inviting embodied interpretations even within digital contexts. When approached from this perspective, designing and referencing information as a whole leads to a holistic system. The blurred and abstracted processes, when transformed within a system, are no longer guided solely by ideal forces. The process itself requires inner forces that are self-organized and self-directed.

While the digital medium may have limited access to these emerging forces, it serves as a catalyst for a new form of digital materiality that enables novel forms of representative articulation. The disparate categories of tangible and intangible fragments, experimental and representative articulations, and analogue and digital materials did not manifest as distinct and disparate interfaces. Instead, they exhibited a unified and continuous quality, particularly in the context of the online studio. Despite the existence of a multitude of disparate options and the prevalence of shared experiences, the tangible materiality of these experiences occupies a superior position in the hierarchy of mutual amenities, facilitating the formation of numerous relationships.

It is crucial to be able to visualize and represent a specific thought or observation using tectonic data within the system, in conjunction with the potentialities of the living environment that arise from the imaginative design process. New tectonic principles and methodologies create a new approach to specialization based on the process. As Cimşit Koş and Gasseloğlu (2020) mentioned, these specializations are highly integrated and reference adaptive operations. Throughout the layers of embodied experience and modeling, the process introduces novel situations and endless possibilities. Despite the virtual environment in which the studio was conducted, a robust connection with tangible fragments persists, particularly with regard to analogue materiality. While intangible fragments engender alternative digital materiality, students possess a more profound familiarity with physical modeling agents. Therefore, seven student projects (e.g., P28 and P17 working with analogue materials (silicone, tree bark with glue) and experimental tectonic articulations involving organic and inorganic hybridization; P5 and P3 exploring both experimental and representative articulations using analog and digital methods (Rhino model-cardboard/styrofoam); P19 and P9 focusing on parametric representative articulations; and P2 working with experimental articulations through clay modeling) were chosen as examples to illustrate the synchronic layers of the process and its interpretations. Meanwhile, all these process images were also part of the final submission, directly integrated into the projects (Table 2).

5. Discussion and conclusion

The aim of this online architectural design studio is to transform spatial knowledge into alternative actions. As Al Maani and Roberts (2023) mentioned a, design studio presents a unique pedagogical environment where students actively contribute to the creation of new knowledge; question existing knowledge; experiment with, modify, and critique their work; learn new skills and pass those skills on to others; and, most importantly, apply them outside the studio walls. The alternative architectural design studio, as an adaptive context that exists between reality and fiction, offers ample topics for discussion. Recently, the dynamics and interactions between design tutors and students have undergone significant changes, necessitating a broader examination of the potentials and challenges of design studios. It is important to recognize that each studio has its own unique dynamics and needs to be configured accordingly. The selected students' projects exemplify distinct yet interconnected approaches to material representation, ranging from purely experimental articulations to more representational engagements. P2's approach is rooted in experimental articulations via material modeling, prioritizing the exploration of material behavior over representational clarity. In contrast, P9 and P19 focus on representative articulations, emphasizing structured communication of material properties rather than open-ended experimentation. Bridging these two extremes, P3 and P5 integrate both experimental and representative articulations, adopting an iterative process where material exploration informs representation and vice versa. Meanwhile, P17 and P28 engage with analogue materials and experimental tectonic articulations, grounding their work in physical, hands-on material explorations rather than digital abstractions. This diverse spectrum of approaches highlights the synchronic and multi-layered nature of material representation in the digital studio, where students navigate between tangible and intangible materialities to construct meaningful spatial and tectonic interpretations.

As Pallasmaa (2017) emphasizes, the hand is central to understanding the "essential qualities of materials and their texture, weight, temperature, and density". In virtual environments, while the haptic dimension may seem diminished, on the contrary, digital tools offer opportunities for rethinking materiality in creative and experimental ways. Throughout the design process, from initial sketches to construction decisions, the interfaces between reality and representation are constantly being questioned through topological and synchronic layering using material modeling techniques. By facilitating a harmonious relationship between the living world and the representative world, it becomes possible to create more responsive environments.The different phases of the process require critical thinking as part of the alternative modeling approach. This process serves as a journey of exploration, wherein each student reacts and processes information in a unique way, thereby creating their own world of materiality, whether in digital or physical form. Embracing a perspective that goes beyond viewing space solely as a physical phenomenon defined by measurements, the intersection of sectional extensions, imagination, and creativity has generated daily fragments that offer a more experimental medium for design.Life encompasses a multitude of diverse and unforeseen possibilities, which do not conform to predefined schemas but rather manifest through interconnected and living interfaces. Representing these interfaces requires approaches that go beyond descriptive, analytical, and objective representations, as they are no longer sufficient to address the complexity of this responsive reality. Content is deeply embedded and embodied within the models. These models are not mere schemas, types, or formal paradigms, nor are they contingent descriptions of possible formal configurations. Instead, they function as synchronic material machines, generating outcomes that closely resemble their own nature. As Freire (1970) mentioned, student means interlocutor or partner in the learning process and progressive education means even when one must speak to people, one must convert the 'to' into a 'with' the people. Students have their own living conditions in the design education process. There is no physical set up or scenario prepared by tutors.

The evolving role of digital tools in architectural design studios necessitates a shift in pedagogical approaches, allowing students to experiment with new forms of materiality and spatial representation, leading to more dynamic and interactive design outcomes. Despite the absence of physical tactile experiences, digital platforms offer a unique opportunity to expand the boundaries of material experimentation, enabling students to conceptualize and visualize complex spatial relationships that are not constrained by traditional material limitations. The hybrid approach combining virtual and physical spaces shows the importance of flexibility in teaching methods, enhancing students' problem-solving skills and creative thinking. This process of transforming abstract design ideas into tangible forms requires students to challenge conventional design thinking, prompting a reconsideration of how space, material, and interaction can coexist in responsive environments. By emphasizing the intersection of imagination, creativity, and materiality, the alternative architectural design studio fosters an environment that encourages risk-taking and exploration, allowing students to develop a deeper understanding of the complex relationship between design intention and realization. Furthermore, this approach highlights the importance of continuous feedback and dialogue between tutors and students, where the tutor's role evolves from an authoritative figure to a collaborative partner in the creative process, echoing Freire's (1970) notion of education as a dialogical process. Future studies should explore the long-term impact of virtual architectural design studios on students' understanding of materiality and space, particularly in terms of their ability to translate digital concepts into physical constructs in real world applications. As architectural design education continues to evolve in response to technological advancements, it is essential for educators to remain adaptive and open to new methods of teaching that align with the rapidly changing dynamics of the profession.

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