Integrating Auditory Perception into Architectural Education and Design

Ebru Erdogan[1*], H. Abdullah Erdogan[2]

[1*] Selcuk University, Department of Architecture, Konya, Turkey, erdogan@selcuk.edu.tr; ORCID; 0000-0001-7415-6567
[2] Konya Technical University, Department of Architecture, Konya, Turkey, haerdogan@ktun.edu.tr; ORCID; 0000-0003-4706-3204

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Abstract

This study extends the scope of architecture beyond visual perception by exploring the parallelism between visual and auditory experiences. It aims to examine the potential outcomes of integrating auditory elements into the design process. Investigating the relationship between auditory stimuli and architecture within the context of design language, the study adopts an experimental approach to explore various dimensions, such as the interaction between sound and architectural thinking and its influence on design processes. Through two- and three-dimensional abstractions of auditory compositions—processed as non-visual design inputs—the study seeks to enhance students' creative thinking capacities. In this context, it examines how variations in auditory tones and stylistic changes influence basic design exercises and architectural reflections. The research consists of an experimental study involving 14 students from the Department of Interior Architecture and Environmental Design, Faculty of Fine Arts, at Selcuk University. Over several weeks, students were exposed to two distinct auditory environments—one characterized by harmony and balance, the other by intensity and dynamism—and tasked with creating designs based on rhythm and structure. To strengthen the study and obtain more objective data, an additional phase was introduced, where the same participants were assigned a different design task—furniture design—following the same methodological approach. This allowed for a comparative analysis of how auditory influences extended across different design contexts. To analyze the relationship between auditory input and basic design, as well as its impact on architectural form, the collected data were systematically structured. The findings indicate that in two separate experiments conducted with the same participants, individuals produced softer lines and forms when exposed to more harmonious stimuli, whereas they preferred sharper, more rigid lines and forms when engaging with high-intensity auditory input.

Keywords: *Architecture, Auditory Stimuli, Education, Basic Design, Creativeness.*

1. Introduction

Architecture, as a discipline inherently shaped by spatial reasoning and sensory perception, has long been informed by interactions with other fields of knowledge. In recent decades, increasing attention has been directed toward the integration of cross-modal stimuli into architectural design processes, particularly those that extend beyond the visual domain. Among these, auditory perception has emerged as a promising cognitive and conceptual tool for enhancing creative thinking, enriching design language, and supporting the formation of spatial narratives. Architecture constitutes a discipline that extends beyond the production of visual aesthetics, possessing the capacity to orchestrate multisensory perception. Core principles such as rhythm, proportion, harmony, and composition indicate that architectural design not only shapes spatial configurations but also structures temporal and perceptual experiences. These foundational principles have historically enabled the establishment of structural and conceptual parallels between architecture and other art forms that engage human cognition and sensation. Architectural environments have frequently been designed as settings for auditory experience, wherein acoustic properties, spatial organization, and atmospheric qualities generate interactions between the user, space, and time. In this context, architecture functions not merely as a physical construct but as an expressive medium capable of evoking emotional responses, producing semantic layers, and facilitating complex sensory engagement. The incorporation of sensory data into the design process offers the potential to expand both the conceptual scope and the pedagogical applications of architectural practice.

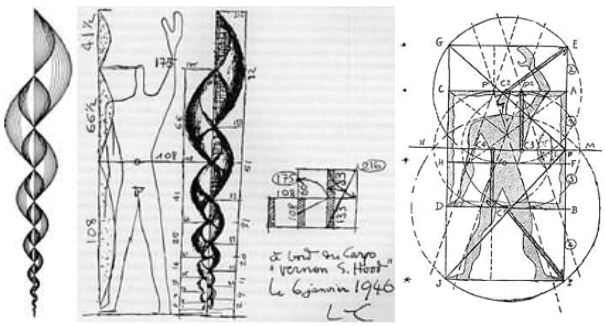


Fig.1. Le Corbusier and Le Modulor

Throughout history, architecture has evolved as a discipline situated at the intersection of mathematical logic and aesthetic intention. Mathematical constructs such as the Golden Ratio and the Fibonacci sequence have served as foundational tools for

articulating proportion and beauty in both visual and auditory domains. Composer Béla Bartók, for instance, systematically embedded these proportional frameworks into auditory compositions. In architectural theory, Vitruvius' anthropometric proportional systems established a legacy of formal reasoning that extended from antiquity through the Renaissance and into modernism. Le Corbusier advanced this tradition by formulating the "Modulor" system—derived from human body proportions—to create a rational framework linking measurement, proportion, and visual harmony in architectural design [1].

A notable example of this interdisciplinary approach is the Philips Pavilion, designed by Le Corbusier, Iannis Xenakis, and Edgard Varèse for the 1958 Brussels World's Fair. The pavilion was realized through the integration of mathematical calculations, architectural design, and a specially composed auditory sequence (Xenakis, 1958; Leopold, 2003). Reflecting Le Corbusier's modernist vision, the Philips Pavilion combined rational geometry with free-form curves, resulting in complex surfaces that challenged the architectural conventions of its time. Drawing from his own composition *Metastasis*, Xenakis developed an architectural concept rooted in mathematical abstraction, transforming glissando transitions into spatial form [2, 3].

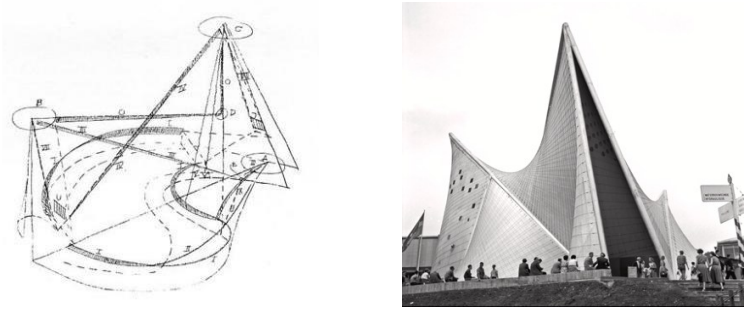


Fig. 2. Auditory diffusion diagram developed for the Philips Pavilion [4].

Daniel Libeskind incorporates his background as a professional virtuoso into his architectural practice through a symbolic and metaphorical framework. For Libeskind, architectural design becomes a medium through which artistic and abstract expressions have materialized within an intellectual and rational structure [5]. A prominent example of this approach is the Jewish Museum, where notions such as absence, invisibility, and void are spatially interpreted in reference to the Jewish Holocaust. These concepts are metaphorically grounded in Arnold Schönberg's Moses and Aron, specifically in the final section titled "Memory Void," which conveys a profound sense of silence and emptiness [6]. In this design, Libeskind does not seek to translate formal elements directly; rather, he reinterprets the sense of incompleteness found in the referenced artistic work by embedding it within architectural form. This results in a spatial experience that symbolically completes and redefines the unfinished aspects of the original piece, revealing a unique conceptual integration [5].

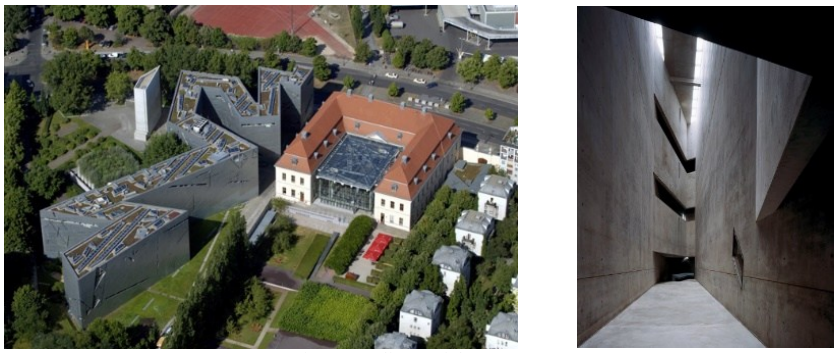


Fig. 3. Berlin Jewish Museum

Throughout history, the relationship between architecture and auditory disciplines has been explored through functional, philosophical, perceptual, and creative frameworks. Despite engaging different sensory modalities, these fields share underlying principles such as harmony, rhythm, proportion, and composition, revealing structural parallels that transcend disciplinary boundaries and inform spatial design processes.

The Functional Relationship Between Architecture and Auditory Disciplines

The functional connection between architecture and auditory disciplines has emerged throughout history through the design of spaces specifically intended for performative sound experiences. Examples include Egyptian hypostyle halls, Roman odea, Greek arenas, medieval cathedrals, and 18th-century aristocratic salons. The acoustic properties of these architectural settings often influenced compositional strategies. For instance, the reverberation characteristics of Thomaskirche shaped the spatial sensibilities in J.S. Bach's works, while Giovanni Gabrieli composed with the unique acoustics of St. Mark's Basilica in Venice in mind, contributing to the development of polychoral arrangements [7].

The Philosophical Relationship Between Architecture and Auditory Disciplines

Philosophers and architects have long drawn metaphorical parallels between architecture and auditory disciplines. Schelling described architecture as "solidified harmony," Schopenhauer as "frozen sound," and Goethe as "silent resonance." Victor Hugo famously referred to Notre Dame Cathedral as "a grand symphony in stone" [8, 9]. In contemporary architecture, Daniel Libeskind's Jewish Museum Berlin embodies this philosophical relationship. Drawing inspiration from Arnold Schönberg's unfinished opera Moses und Aron, Libeskind created a spatial narrative rooted in absence and fragmentation, expressing conceptual ideas that mirror auditory abstraction [5, 6].

The Perceptual Relationship Between Architecture and Auditory Disciplines

The perceptual link between architecture and auditory disciplines lies in how each is experienced—auditory forms unfold through time, whereas architecture is encountered through spatial immersion. According to Murray, perception operates on three levels: sensory, semantic, and technical. Sensory perception refers to the intuitive enjoyment of spatial and sonic environments. Semantic perception involves the communication of meaning through variation and repetition, while technical perception addresses structural elements such as rhythm, harmony, material choice, and construction methods. These foundational components foster both aesthetic unity and functional clarity across disciplines [7].

The Creative Relationship Between Architecture and Auditory Disciplines

The creative processes in architecture and auditory disciplines share stages such as analysis, conceptualization, and synthesis. While some creators envision works as complete forms from the outset, others develop them incrementally. In architecture, figures like Mies van der Rohe and Le Corbusier exemplified this process by blending logic, aesthetics, and material innovation. Likewise, architects such as Erich Mendelsohn and Daniel Libeskind have drawn on frameworks derived from auditory disciplines to articulate complex spatial ideas. Mendelsohn likened horizontal and vertical architectural elements to melodic and harmonic constructs, whereas Libeskind employed abstract auditory principles to reconceptualize spatial and structural expression [6].

2. Basic Design in Architectural Education

The concept of Basic Design is an approach that introduces a visually oriented thought system to architectural education and forms the foundation of this education [10] (Denel,1981). The Beaux-Arts school, established by Violette-le Duc and Labroust in 1819, was the first significant model that provided a theoretical framework for architectural education. However, this school was criticized for offering an educational approach that was closed to interdisciplinary interactions and considered unrealistic and irrational. The Bauhaus School, founded in 1918, transformed the course of architectural education by being the first institution to implement Basic Design Education. In the manifesto published by Walter Gropius in 1919, it was emphasized that the purpose of education was not merely the transmission of knowledge but the development of broad and inclusive approaches to various design problems. Unlike the Beaux-Arts school, Bauhaus emphasized creativity, imagination, and opportunities for individual expression. Furthermore, the Basic Design Course developed by Wassily Kandinsky at Bauhaus gained a new dimension through its association with musical harmony theories, particularly through the concept of colour [11].

In Turkey, as in many other countries, the "Basic Design Studio," which is one of the fundamental first-year courses in architecture schools, serves as a transitional phase from the memorization-based and repetitive environment of secondary education to the higher education environment that requires creative and critical thinking. The concept of Basic Design teaches students from architecture schools with different qualities how to observe, perceive, think, and organize the visual world by synthesizing all these aspects. Lang (1998) emphasizes that when adapting the criteria of the Bauhaus Basic Design Studio to contemporary conditions, the following objectives emerge for a foundational course [12]:

Development of Creativity: As creative thinking is developed through various methods and adapted to Basic Design, creativity in practice encompasses three main stages: gathering facts (Analysis), generating ideas (Idea), and finding solutions (Synthesis) [10].

Development of Perceptual Ability: Another objective of Basic Design Education is to integrate subconscious and conscious thinking into a unique, cohesive whole. In this context, the 'Gestalt Perception Theory' has made significant contributions to Basic Design Education.

Formation and Development of Design Language: Architectural education teaches students the connections between perception and sensation through basic design concepts. Perceptions and sensations, which are transformed into imagery in the creative mind, are converted into architectural composition through a design language.

Development of Problem-Solving Skills: If all art and design activities are considered as a problem-solving process, each method leading to a solution can be seen as a cyclical series of steps that divide the design-making activity from abstraction to concreteness.

2.1 The Relationship Between Architecture and Auditory Disciplines in the Context of Composition

In creating an artwork, artists utilize specific concepts embodying ideas or thoughts to convey their intended messages effectively. By employing these concepts, artists direct their creative processes in alignment with their chosen subjects. Among the essential concepts in art construction is composition, defined as the deliberate arrangement of all parts contributing to a cohesive whole. Composition is a universally recognized concept across diverse art disciplines, including architecture, painting, sculpture, and music, playing a significant role not only during the design phase but also in the presentation stage. Another notable relationship between architecture and auditory disciplines is that the products of both disciplines inherently possess compositions meticulously structured through design. The realization of composition as a concept is common to all artistic fields and is primarily achieved through four fundamental elements: rhythm, texture, harmony, and theme. These four elements, which form the basis of composition, branch into closely related and interconnected subcategories. Sub-themes such as repetition, proportion, and style further illustrate the intricate relationships within these concepts. Therefore, composition itself serves as a comprehensive term encompassing all these interconnected sub-themes [13]. The conceptual similarities between compositions of architectural and auditory disciplines have been examined through subcategories under the headings of rhythm, harmony, texture, and theme, supported by examples;

Rhythm: Rhythm is formed by the interaction of movement and time, enabling the orderly repetition of elements [14]. In auditory disciplines, rhythm emerges from the regular repetition of sounds through emphasis, duration, and tonal qualities, whereas in architecture, it is established through the harmonious repetition of solid-void ratios, colour variations, and shaded-open areas [15]. In architecture, rhythm creates an aesthetic and functional composition through the arrangement of structural elements (columns, beams, spatial modules) and surfaces [13]. This is a form of arrangement that directs the spatial composition of architecture and shapes perception.

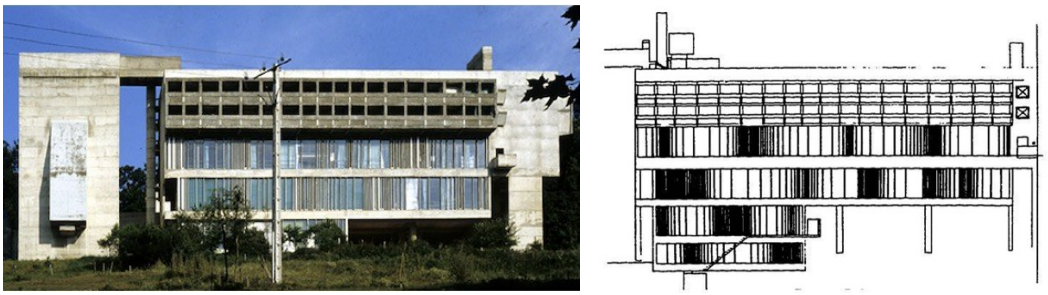


Fig. 4. The wave-like glass expression—embodying rhythmic, melodic, and harmonic elements—was designed by Xenakis using Le Corbusier's Modulor system [16]

The similarity between architecture and auditory disciplines lies in the experience of rhythm over time in both disciplines. Just as rhythm provides a sense of temporal order in auditory compositions, it similarly defines the spatial logic and expressive cadence of architectural works [17].

Texture: The concept of texture is significant in architecture and auditory disciplines, as it is in many other disciplines such as botany, biology, histology, literature, art, geography, urban planning, mathematics, and textiles. Texture refers to the arrangement of components that come together harmoniously to form a unified whole [18]. In art, texture provides visual richness. According to Roth [17], texture in architecture consists of optical texture, which refers to visual patterns, and tactile texture, referring to surfaces that can be physically perceived. In urban planning, the concept of urban texture emerges prominently, while spatial texture is highlighted in architecture. In auditory disciplines' composition, texture, alongside rhythm, harmony, and melody, defines the auditorial structure and constitutes one of the fundamental components determining auditory composition. According to Mies van der Rohe, materials gain significance as they transform into architectural expression. Both architecture and auditory disciplines derive meaning through the arrangement of textural elements [13].

Harmony: Harmony is derived from the Latin word "harmos" (connection) and refers to compatibility and concord. In art, harmony is the arrangement of elements to create a cohesive and balanced order. According to Vitruvius, harmony is achieved through the symmetrical and proportional arrangement of a structure [19]. For Le Corbusier, architecture is about creating emotional relationships and visual harmony through the arrangement of forms. He describes architecture as the harmonious arrangement of shapes under light [20]. In auditory disciplines, harmony refers to the creation of a cohesive unity through the combination of multiple tonal elements, whereas in architecture, it signifies the relational coherence between individual components and the overall structure. The conceptual connection between architecture and auditory disciplines is rooted in the mathematical frameworks proposed by Pythagoras and Plato. During the Renaissance period, notions of harmonic order derived from auditory theory were associated with the classical column systems of Greek temples [9]. Mathematician-architects such as Leon Battista Alberti also integrated the notion of harmony into their theoretical and practical works. In architectural discourse, harmony—often associated with vertical structuring in compositional systems—is closely linked to principles of measurement, proportion, and ratio. Mathematical frameworks such as the Golden Ratio and the Fibonacci sequence have historically served as reference models for achieving formal and aesthetic balance across both architectural and auditory disciplines. Notably, Béla Bartók was among the first to systematically incorporate these proportional systems into auditory structures. Ultimately, harmony in both architecture and auditory design reflects a shared pursuit of coherent unity, establishing the foundational basis for both aesthetic refinement and structural resolution across disciplines.

Theme: The concept of theme refers to the main subject, fundamental motif, or core idea, and constitutes one of the most essential elements underpinning the theoretical foundation of artistic works. It plays a central role in elevating a creation beyond technical execution into the realm of expressive and conceptual artistry. In creative disciplines such as architecture and auditory arts, the theme serves as a vehicle for articulating ideas through a range of conceptual frameworks, methodologies, and processes. In architecture, thematic expression emerges through the deliberate and distinctive organization of structural elements, whereas in earlier historical contexts, such thematic frameworks were often derived from nature-inspired conceptualizations. In auditory disciplines, by contrast, the theme is typically understood as a guiding motif or compositional idea that structures the overall coherence of a work, particularly through its influence on rhythm and harmony [21]. Despite differences in materiality and form, the theme functions in both domains as the principal agent of conceptual clarity and expressive depth. According to Collingwood, it is the presence of a theme that transforms a technical product into a genuine work of art.

This study investigates the potential impact of integrating auditory disciplines into the architectural design process by extending the scope of design beyond visual perception and establishing conceptual parallels between visual and auditory cognition. Within this framework, the research aims to enhance students' creative capacities by utilizing two- or three-dimensional abstractions derived from compositional structures inherent in auditory art forms.

3. Method

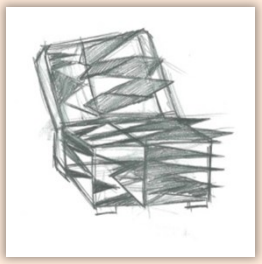
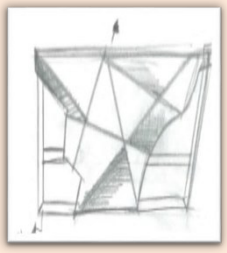
This study aims to investigate how auditory disciplines influence human creativity and to examine the extent to which variations in tonal characteristics and stylistic expressions are reflected in students' basic design outputs and, subsequently, in architectural design processes. The study consists of an experimental process involving 28 students from the Department of Interior Architecture and Environmental Design, Faculty of Fine Arts, Selcuk University. Two distinct auditory genres—Classical (Itzhak Perlman & London Philharmonic Orchestra, "Four Seasons, Op.8, Spring: Allegro") and Rock (System of a Down, "Chop Suey") —were played for a group of 14 students (6 females, 8 males) during different weeks, and the students were instructed to create designs influenced by rhythm and harmony. To enhance the methodological robustness of the study and ensure greater objectivity, the procedure was replicated with an additional group of 14 students (5 females, 9 males). These participants engaged with the same two auditory genres over separate weeks and were tasked with designing furniture. In order to systematically examine the relationship between auditory input, basic design principles, and furniture design, the collected data were categorized and organized into tables. The analysis focused on how the two auditory genres—Classical and Rock—affected the design process, and how specific auditory characteristics were translated into architectural lines, forms, and spatial expressions.

4. Evaluation

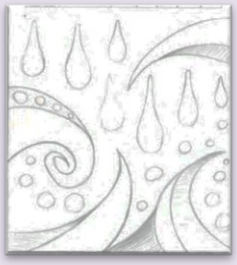
Auditory Stimuli in Architecture: Form, Shape, and Line Parameters

In examining the synchronization between auditory input and architecture, this study aimed to investigate the interaction between these two parameters, revealing that students demonstrated varying creative performances influenced by different auditorial genres. When the same group of 14 students was exposed to two distinct auditory genres, they produced markedly different and independent designs. Throughout the design creation process accompanied by auditory stimuli, the majority of students consistently made similar formal and linear choices to express their thoughts and ideas, despite referencing different objects. In this study, the designs created by students were analysed and tabulated (Tab. 1) to observe the influence of Classical and Rock music on their creative outputs. Findings indicated that the characteristics of the music—specifically, soft versus harsh tones—not only influenced the design process itself but were clear in the final designs. Two separate experiments conducted with the same individuals at different times revealed that exposure to Classical music led students to create designs characterized by softer, more organic forms, while exposure to Rock music resulted in preferences for harsher, sharper forms, including triangular patterns and zigzag lines. Conducting the study with the same participants across different weeks validated that the observed differences in design outputs were attributable solely to the auditorial genres played.

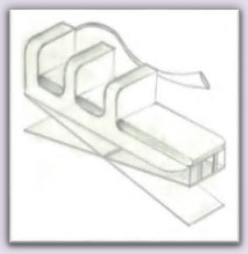
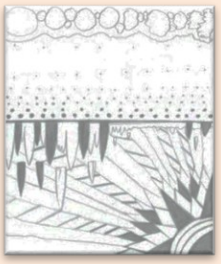
Tab. 1a. The Influence of Two Different Auditory Genres (Classical Music, Rock Music) on Students' Basic Design and Furniture Design Outputs (G:Gender; F: Female, M:Male).

G	Classical Music	Rock Music	G	Classical Music	Rock Music
1 F			F		
2 F			M		
3 F			F		
4 M			M		

Tab. 1b. The Influence of Two Different Auditory Genres (Classical Music, Rock Music) on Students' Basic Design and Furniture Design Outputs (G:Gender; F: Female, M:Male).

G	Classical Music	Rock Music	G	Classical Music	Rock Music
5 M			M		
6 M			M		
7 F			M		
8 M			M		
9 F			F		
10 F			F		

Tab. 1c. The Influence of Two Different Auditory Genres (Classical Music, Rock Music) on Students' Basic Design and Furniture Design Outputs (G:Gender; F: Female, M:Male).

G	Classical Music	Rock Music	G	Classical Music	Rock Music
11 M			M		
12 M			F		
13 M			M		
14 M			M		

The phase in which ideas materialize and transform into tangible forms through auditory input was also examined using furniture design exercises. Similar to the basic design phase, 14 students were asked to develop furniture designs after being exposed to two different auditory genres. Although the methodological framework remained consistent, the participants in this stage of the study were different from those in the previous phase. The same two auditory genres—Classical and Rock—were presented. Analysis of the students' works revealed that designs created while engaging with Classical auditory input predominantly featured rounded lines and organic forms. In contrast, those developed under the influence of Rock displayed modern characteristics, particularly in the use of sharp-edged forms. These findings suggest that, although different auditory genres evoke varying emotional responses, they tend to generate consistent formal associations among individuals. The recurring design tendencies observed across both experiments support and validated each other. Accordingly, the study concludes that auditory stimuli significantly influence the transmission of ideas and the development of compositional strategies within design education, including fields such as interior architecture, architecture, and industrial design.

5. Conclusion and Suggestions

Auditory disciplines and architecture intersect as complementary fields that deepen artistic perception and enrich spatial experience. Approaching architecture not merely as a visual art but as a temporal and spatial discipline perceived through all senses contributes to the development of innovative approaches in design processes. The literature indicates that architecture and auditory disciplines are grounded in comparable design principles, with both being intricately interwoven with aesthetic, mathematical, and perceptual dimensions. Numerous studies have shown that auditory disciplines have historically influenced spatial design and that this influence is reflected in architectural practice. However, this study distinguishes itself from previous research by analysing how distinct auditory genres influence students' design processes through a two-phase approach and by evaluating both the perceptual and tangible reflections of these influences in basic design and furniture design works.

The aim of this study was to observe how auditory input affects creativity, how differences in tonal structures and stylistic variations influence students' design outputs, and how these effects are ultimately reflected in architectural thinking and production.

The study examined how the integration of auditory stimuli into the design process—within the parallelism of visual and auditory perception—shapes the progression and outcome of creative work. It was concretely demonstrated that auditory genres such as Classical and Rock influence individuals' design processes during the development of their projects. Based on the analysis of student work, observable differences in line quality, formal diversity, and conceptual expression emerged. These findings indicate that auditory input significantly impacts both architectural and auditory composition, affecting not only the design process and final outcomes but also leaving distinct conceptual impressions. Despite employing different materials and tools in their creative processes, designers tended to converge on common ground in expressing intent, emotion, and thought. It was observed that tonal characteristics had comparable effects on the architectural and design compositions produced by the students. Furthermore, it is suggested that auditory input can influence various aspects of architectural design—including project conception, thematic development, initial decisions, and, more broadly, the form-generating thought process.

When examining both the basic design and furniture works, even the manner in which lines were drawn on paper clearly reflected the influence of the auditory input being experienced. Therefore, it can be concluded that auditory stimuli contribute to variation in compositional structure and idea transmission within design education fields such as architecture, interior architecture, and industrial design. In this context, integrating auditory elements into architectural education and employing them as analytical tools within design processes emerges as a promising method to foster creativity and critical thinking. By concretizing the theoretical relationship between architecture and auditory disciplines through experimental means, this study strengthens interdisciplinary connections and provides a foundation for future research.

Auditory disciplines can profoundly influence how architecture is understood and perceived, shaping the formation and development of an individual's architectural style. The ability to analyse an auditory composition conceptually, theoretically, structurally, and in terms of pattern can enhance and strengthen architectural composition. Based on the findings of this study, auditory engagement may play a significant role in foundational education, beginning in early childhood. Future research could investigate how structured auditory training contributes to various aspects of child development, including perception, abstraction, creativity, problem-solving, self-expression, and self-confidence. Likewise, auditory input may be employed as a pedagogical tool in basic design education within schools of architecture. This approach could support the development of a methodology that integrates auditory and visual elements into the design education process. It is anticipated that foundational training in auditory composition can contribute to architecture students' abilities in perception, abstraction, creativity, problem-solving, and the development of a unique design language. Approaching architecture not solely through the lens of visual perception but through multisensory engagement may encourage designers to explore new dimensions. This multidisciplinary approach suggests that integrating auditory disciplines into architectural education could inspire innovative design solutions and expand the creative capacity of future practitioners.

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