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Embodied Spatial Learning: Enhancing Design Education Through Experiential Pedagogy and Cognitive Engagement

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ABSTRACT

Understanding space as an embodied and cognitive construct is fundamental in early architectural and interior design (AnID) education. This study introduces a workshop-based pedagogical model aimed at enhancing spatial sensitivity, representation, and imagination among first-year AnID students. Informed by post-pandemic challenges in design learning, the research integrates experiential activities—such as spatial accessibility, proxemic zones, furniture layout, and public space configuration—into an immersive learning framework. A mixed-methods approach involving 45 students utilized pre- and post-surveys alongside in-depth interviews to evaluate affective and cognitive outcomes. The results indicate significant improvements in spatial cognition, design confidence, and student motivation. These findings support a shift from abstract, theory-only models to embodied learning environments, aligning with neuro-architectural discourse on the multisensory nature of spatial perception. The study affirms that integrating cognitive and physical processes within the design curriculum fosters deeper spatial understanding and creative capacity in foundational design education.

Keywords: architecture pedagogy, awareness, education, spatial

1. Introduction

Spatial ability is essential in design education, encompassing the capacity to represent, manipulate, and resolve spatial problems through concrete solutions. It includes multiple dimensions—spatial reasoning, cognition, intelligence, and sense—that form the cognitive foundation of the design process [1]. For architecture and interior design (AnID) students, spatial awareness is a vital skill that underpins ideation, iteration, and solution development [2]. Neuro-architectural research emphasizes that spatial experience is processed neurologically, not merely visually. Forms such as curvilinear geometries stimulate emotional and cognitive responses, reinforcing the importance of embodied spatial interaction in design education [3]. This perspective supports immersive learning strategies that involve the body, senses, and movement—allowing students to internalize spatial knowledge beyond abstract concepts.

Cognitive processes such as visual-spatial thinking, working memory, and long-term memory are instrumental for AnID students to visualize and integrate design ideas [4][5]. A well-developed spatial sense enables students to translate conceptual thoughts into coherent spatial arrangements and navigate between two- and three-dimensional representations [6][7]. Such cognitive engagement is crucial to producing contextually grounded design outcomes [8].

The COVID-19 pandemic prompted a global shift to online education, disrupting traditional design studio models and reducing opportunities for physical interaction. While digital platforms provided flexibility, they also introduced challenges in accessibility, technological reliability, and social engagement [5][9]. Studies have noted a decline in design empathy and embodied understanding during this period, highlighting the limitations of virtual-only learning models [10]. Post-pandemic pedagogical discourse now emphasizes the reintegration of physical, sensory-rich experiences to restore spatial awareness and engagement in design education [11][12].

Various strategies have been explored to address these challenges, including multidisciplinary collaboration, immersive technology, and hands-on technical learning [2]. Yet, many of these approaches lack emphasis on embodied experience and its direct role in shaping spatial cognition. Research has shown that environmental design—such as daylight quality—can significantly affect student mood, attention, and task performance in studio-based learning [3][13]. These findings point to the importance of designing not only the content but also the context of spatial learning environments.

Blended pedagogies that combine theoretical instruction with practical engagement have been found to increase student motivation, cognitive activation, and creative outcomes [14][15]. Experiential learning, particularly in the form of workshops, activates multisensory perception, allowing students to develop a more intuitive understanding of spatial relationships [16]. Despite this, few studies have focused specifically on the role of workshop-based activities in fostering spatial awareness and imagination among early-year AnID students.

In response, this study introduces an integrative workshop method developed for first-year architecture and interior design students. Building upon prior theoretical lectures in spatial and ergonomic design, the workshop immerses students in simulated spatial scenarios that encourage bodily engagement and peer observation. The study evaluates the effectiveness of this method in three areas: spatial awareness, the ability to represent spatial information, and the imaginative capacity to translate experience into design.

In conclusion, the previous discussion strongly affirms that spatial ability is not merely a cognitive skill but a deeply embodied, multisensory process that is central to effective design education. Proxemics theory, which explores how individuals perceive and use space in social contexts, provides a vital framework for understanding the experiential dimensions of spatial learning. By recognizing the nuanced interplay between the body, environment, and spatial cognition, proxemics enriches pedagogical strategies that seek to foster awareness of scale, distance, and spatial relationships. This is particularly relevant in design education, where the ability to navigate, interpret, and design within varying spatial contexts is essential. The shift toward digital learning during the COVID-19 pandemic underscored the irreplaceable value of physical presence and sensory engagement in cultivating these abilities. As the experimental nature of architectural pedagogy evolves, there is a growing imperative to reintegrate embodied practices through experiential pedagogies such as workshop-based learning, which is the core of analysis in this paper. These methods not only enhance spatial cognition and creative output but also align with proxemics principles by situating learners within real and simulated spatial contexts. Therefore, the integration of embodied spatial learning into early design education deepen students' spatial intelligence, enrich their design thinking, and ground their creative processes in lived spatial experience, as will be showcased in the results.

2. Method

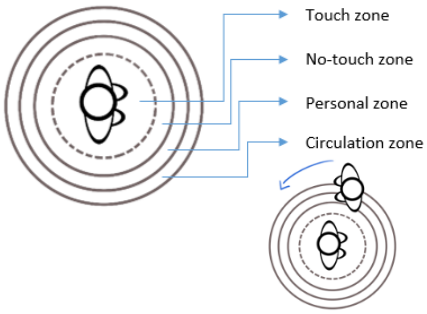
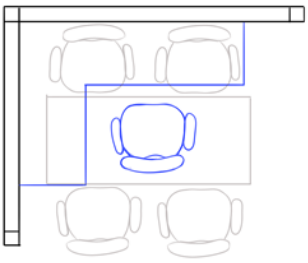
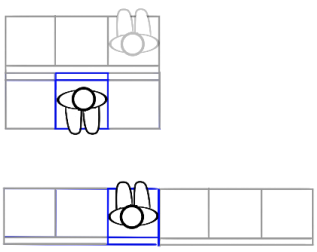
This study employed a mixed-methods approach to investigate how experiential, workshop-based learning influences the spatial awareness of first-year students in the Architecture and Interior Design (AnID) programs

at President University. The participants were purposefully selected based on their early stage in the design curriculum, making them appropriate subjects for evaluating fundamental spatial cognitive development [5,8].

Three core spatial dimensions were adapted from prior literature: (1) awareness of space, (2) representation of spatial information, and (3) imagination of space in design [4][11]. These dimensions were assessed using pedagogical indicators—enjoyment, intention, and motivation—commonly used to evaluate affective learning outcomes [5][12]. The indicators were operationalized into Likert-scale survey items (a scale of 1-5, where 1 is the least value and 5 the highest), which were distributed before and after the workshop to 45 participants (27 architecture students and 18 interior design students).

The workshop took place at the university's convention center, selected for its spatial flexibility and suitability for simulating physical-scale design scenarios. The following four structured tasks, explained in Table 1, were executed in rotation, allowing each student to participate directly and observe peers alternately.

Table 1 Various Activities in the Spatial Awareness Workshops

Activity Description	Illustration	Documentation
Accessibility Simulation Students navigated corridors of different widths to experience spatial constraint and flow, while observers noted behavioral and emotional responses. This exercise encouraged reflection on proxemics and circulation—key elements in spatial cognition [4][13].		
Buffer Zone Awareness A central student model was surrounded sequentially by peers acting as strangers, acquaintances, friends, and close companions, to simulate social distance boundaries. The activity illustrated emotional perception of spatial proximity [14].		
Furniture Arrangement Exercise Working in groups, students created 2D layout plans and translated them into 1:1 real-scale furniture configurations. This tested spatial planning, anthropometry, and ergonomics, while encouraging collaborative spatial thinking [2][13].		
Public Space Layout Observation Various seating arrangements were modeled on real-world public environments (e.g., cafes, parks). Students alternated between occupying and observing these layouts to evaluate how spatial form influences user comfort [3].		

Survey data were collected twice: once prior to the workshop to assess students' baseline perceptions of space and again afterward to detect shifts in engagement and understanding. To triangulate findings, in-depth

interviews were conducted with four representative students—two from each program—selected based on their reflection notes and active engagement [14][15]. The interviews explored individual cognitive responses, emotional reactions, and design-thinking processes triggered by the workshop activities.

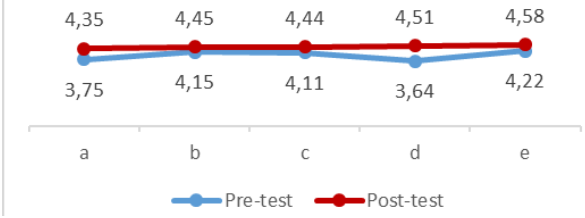
Data were analyzed using a triangulation strategy combining quantitative changes in survey scores with qualitative data from observations, interviews, and student reports [8][12]. This methodological layering ensured both reliability and richness in understanding how embodied spatial experience influences cognitive and emotional learning in design education.

3. Results and Discussion

Engaging students actively is crucial to increasing participation and deepening understanding in design education. Teaching teams play a vital role in cultivating participatory learning environments, especially by fostering collaborative and supportive relationships [17]. To support this, an integrative workshop-based method was implemented, involving students from both Architecture and Interior Design (AnID) programs at President University.

The workshop targeted key spatial competencies essential for AnID students—spatial awareness, spatial information representation, and imagination in design. These dimensions were evaluated both quantitatively and qualitatively, highlighting the pedagogical advantages of embodied, experiential learning. A summary of students' general perspectives before and after the workshop is shown in Table 2, indicating a marked improvement across all aspects.

Table 2 Students' General Understanding of Spatial Awareness

Statement	Code	Chart
The definition of spatial awareness	a	
The importance of spatial awareness for architecture and interior design students	b	
Overall perspective of awareness of the space	c	
Overall perspective of representation of spatial information	d	
Overall perspective of imagination of space in design	e	

Quantitative data indicated significant gains in students' comprehension following the workshop. The blended learning approach—integrating theoretical lectures and physical simulation—proved particularly effective for developing spatial sensitivity and overcoming limitations posed by conventional classroom methods [9,13,18]. Students' understanding of spatial awareness improved from 3.75 to 4.35, while their ability to interpret spatial information increased from 3.64 to 4.51.

3.1. Awareness of Space

Students reported greater enjoyment in learning about spatial awareness following the workshop (4.1 to 4.7). Conversely, their perception of the effectiveness of purely theoretical instruction slightly declined (3.95 to 3.9). Kinesthetic experiences, such as those provided in the workshop, have been shown to enhance learning outcomes in design education significantly [19]. This was echoed in interview responses, where students emphasized that direct spatial experiences helped them understand abstract concepts more effectively.

Students' intentions to further develop spatial sensitivity rose from 4.05 to 4.60, and their motivation to engage with spatial issues increased from 4.35 to 4.55. These results support the claim that physical, embodied engagement strengthens design cognition and emotional connection to learning material [12][16].

Interview findings revealed that students appreciated the dual perspective offered in the workshop: they were able to act as both designers and users, increasing their empathy and perception of spatial relationships. Prior research indicates that this dual role enhances students' ability to produce user-centered and contextually appropriate designs [6][10].

3.2. Representation of Spatial Information

Students' ability to comprehend and visualize spatial dimensions improved significantly, with their understanding of spatial size rising from 2.90 to 4.45 and spatial imagination from 3.45 to 4.40. Traditional lecture-based methods often fail to convey the nuances of spatial proportion and scale, whereas experiential simulations enable students to "feel" spatial parameters [2][14].

AnID students' understanding of how spatial configurations affect comfort and functionality also improved (3.75 to 4.65). Students reported better engagement and higher motivation to explore spatial representation (4.05 to 4.55). These findings support existing research on the impact of embodied cognition in architectural education, particularly in scenario-based learning [15][20].

The interviews underscored how students found physical experimentation in the workshop particularly effective for understanding anthropometry and public space design. Workshop simulations translated abstract spatial metrics into lived, memorable experiences that improved their design intuition and visualization skills [4][8].

3.3. Imagination of Space In Design

The workshop had a strong impact on students' ability to imagine and manipulate space in design. Scores for imagination rose from 3.80 to 4.55, and students reported increased confidence in applying spatial knowledge to their design process (3.95 to 4.55). The simulation activities allowed them to better connect user behavior with design intent, thereby enhancing their creative problem-solving capacity [5][7].

Students also became more motivated to experiment with spatial composition (4.55 to 4.75), and their sensitivity to spatial comfort and accessibility improved significantly (4.65 to 4.85). This supports prior research indicating that direct spatial experience forms the foundation of empathetic and emotionally resonant design solutions [6][13].

Interview data confirmed that students initially struggled with visualizing spatial layouts and user comfort. The post-workshop reflections revealed that trial-and-error in simulated environments offered meaningful feedback loops that enriched their design thinking.

4. Conclusions

This study highlights the effectiveness of embodied, workshop-based learning in enhancing spatial awareness, representation of spatial information, and imaginative capacity among first-year architecture and interior design (AnID) students. Findings confirm that direct physical engagement within structured spatial scenarios significantly improves students' cognitive and emotional connection to design processes. The integration of theory and physical experience—through activities simulating accessibility, buffer zones, furniture arrangement, and public space layouts—proved to be a powerful pedagogical strategy in bridging conceptual understanding with lived spatial perception.

Survey results demonstrated a clear improvement in students' enjoyment, intention, and motivation across all three measured dimensions of spatial competence. These outcomes were further validated by qualitative insights from interviews, which revealed deeper emotional engagement and empathy through bodily interaction with space. The integrative workshop format not only supported students in developing a more intuitive grasp of spatial scale, comfort, and function, but also increased their confidence and creativity in design-based problem-solving.

The research contributes to the evolving discourse in post-pandemic design education by demonstrating that experiential, multisensory learning models can effectively restore the spatial cognition and empathy diminished during online learning periods. It suggests that early exposure to embodied spatial learning should be embedded into the AnID curriculum as a foundational pedagogical tool. Future studies may further explore how long-term application of workshop-based learning influences students' design outputs over time, and how such models can be scaled or adapted for more advanced studio practices.

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6. Conflict of Interest

This study was personally funded by the authors, which limited the scale and resources of the experimental implementation. As a result, the workshop utilized simple, cost-effective materials, relying heavily on the creativity of the research team to create impactful spatial experiences for students.

While the activity demonstrated meaningful pedagogical outcomes within a single institutional context, further research is recommended to test the effectiveness of this learning method across multiple design institutions. The authors declare no financial or personal conflicts of interest related to the content or findings of this paper.

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