

The Influence of Spatial Layout on Learning Outcomes, Safety, and Productivity in Educational and Work Environments: A Systematic Literature Review

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Abstract- *This study presents a systematic literature review examining how spatial layout influences learning outcomes, safety, and productivity within educational and workplace environments. Recognizing space as an active determinant of human performance, this review synthesizes findings from fifteen peer-reviewed studies published between 2010 and 2024. Using the PRISMA framework, the research identifies spatial features (such as flexibility, environmental quality, circulation, and ergonomic design) that significantly impact user outcomes. In educational settings, adaptable layouts, daylight access, and acoustic balance were found to enhance student engagement, collaboration, and academic achievement. In workplace contexts, spatial factors like ventilation, lighting, and seating configuration were linked to improved employee satisfaction, cognitive performance, and overall productivity. Although safety is often treated implicitly, evidence suggests it is embedded in broader spatial factors such as visibility, mobility, and environmental control. The study further reveals strong convergence in spatial strategies across contexts, yet notable divergences in priority, measurement, and application. Gaps include the limited exploration of safety as a discrete outcome, insufficient longitudinal data, and a lack of studies from developing contexts. The review concludes by recommending holistic, user-centered spatial designs that integrate flexibility, safety, and productivity considerations to support optimal human performance in institutional environments.*

Indexed Terms- *Design Strategy, Educational Spaces, Human Performance, Spatial Layout, Workplace Environment*

I. INTRODUCTION

The spatial layout of educational and workplace environments plays a critical role in shaping user experiences, influencing not only the quality of interactions within these spaces but also significantly impacting learning outcomes, safety, and productivity (Papaioannou, Volakaki, Kokolakis & Vouyioukas, 2023). As contemporary institutions and organizations strive to enhance performance, collaboration, and well-being, the importance of well-considered spatial configurations has moved to the forefront of design and planning discussions (Krstić, Filipović, & Ristić, 2024). In educational settings, research has increasingly demonstrated that the arrangement of physical spaces (such as classroom layouts, circulation patterns, lighting, acoustics, and furniture configuration) can profoundly affect students' concentration, engagement, and academic performance (Nja, Anari, Erim, Idiege, Ilhami, Ukah & Cornelius-Ukpepi, 2023; Reinius, Korhonen & Hakkarainen, 2021). Likewise, in work environments, especially those emphasizing knowledge work and innovation, spatial organization has been linked to increased collaboration, reduced errors, and improved job satisfaction (Tabejamaat, Ahmadi, Barmayehvar & Banihashemi, 2024). Safety, often considered a baseline requirement, is also deeply intertwined with layout decisions, influencing factors such as emergency response, visibility, ergonomics, and accessibility (Son, 2023).

Despite the growing body of knowledge on this subject, existing literature remains fragmented, often focusing on isolated variables within either educational or occupational contexts. There is a need for a comprehensive synthesis that not only collates findings from diverse studies but also

highlights recurring themes, methodological approaches, and gaps in research across both sectors. This study aims to draw connections between spatial design and human outcomes, thereby informing evidence-based design strategies for architects, educators, organizational managers, and policymakers. This review is anchored on the following research objective: to evaluate how spatial layout influences learning, safety, and productivity in educational and work environments. Specifically, the review seeks to identify key spatial elements that contribute to or hinder these outcomes, assess the methodological robustness of existing studies, and highlight implications for the design of future learning and workspaces. This literature review contributes to the discourse on spatial efficiency and user-centered design by offering an integrated understanding of how space planning affects human behavior and performance across different but comparable environments. The insights drawn from this study are expected to support better-informed decisions in architectural and facility design, particularly in environments where learning and productivity are core priorities.

II. LITERATURE REVIEW

Spatial layout refers to the organization, arrangement, and interrelation of physical elements within a built environment (Yamu, Van & Garau, 2021). In both educational and work contexts, this includes the positioning of furniture, the flow of circulation, spatial zoning, visibility lines, spatial density, and the integration of environmental systems such as lighting, ventilation, and acoustics (Nja, et al., 2023; Reinius, Korhonen & Hakkarainen, 2021). Effective spatial layouts are those that enhance the functional, psychological, and social experiences of users within the environment (Dong, Ibrahim & Azahari, 2024). The theoretical foundations for studying spatial layout derive from environmental psychology, ergonomics, human-centered design, and socio-spatial theory. These disciplines emphasize how physical space influences cognition, behavior, and well-being. The theory of affordances (Gibson, 1979) suggests that spatial arrangements provide cues that support or constrain particular behaviors (Widmer & Rérat, 2025), while proxemics theory (Hall, 1966) deals with how spatial relationships affect

communication and interaction (Kabir, Alkali, El-nafaty & Dodo, 2021).

Research on the impact of spatial design in educational environments reveals that classroom layout significantly affects student engagement, teacher interaction, and learning performance (Peng, Deng & Jin, 2022). Open and flexible layouts are increasingly favored over traditional, rigid arrangements, particularly in 21st-century learning models that emphasize collaboration, creativity, and critical thinking (Adera, 2025). According to studies by Abdul-Latip, Abdul-Latip, Tamrin & Rahim (2025 and Al-Jokhadar, Alnusairat, Abuhashem & Soudi (2023, factors such as access to natural light, seating arrangement, mobility of furniture, and acoustical quality have measurable effects on students' academic outcomes and satisfaction. Classrooms with adaptable layouts have been shown to support varied teaching methods (lectures, group work, and hands-on activities) enhancing inclusivity and active learning (Young, Hynes & Hynes, 2021). Moreover, spatial configuration can influence students' sense of belonging and psychological safety, both of which are linked to cognitive performance and motivation (Formisano, 2024). High-density classroom layouts, on the other hand, are associated with distractions, stress, and limited teacher-student interaction.

In the context of workplaces, especially in knowledge-based and creative industries, spatial layout has a direct relationship with productivity, communication patterns, and employee satisfaction (Pakos, 2024). The shift from enclosed offices to open-plan workspaces aimed to encourage collaboration and innovation; however, evidence suggests mixed outcomes. Sugiyama, Hadgraft, Clark, Dunstan, Chevez, Healy & Owen (2021) noted that while open-plan layouts can increase spontaneous interaction, they may also introduce distractions and reduce individual focus. More recent research advocates for hybrid layouts that combine open areas, quiet zones, and collaborative spaces to support a range of work styles (Nabergoj & Uršič, 2024). The role of spatial design in influencing physical movement, team proximity, and even posture also plays into productivity. Ergonomic layouts that reduce physical strain and offer standing options

are linked to better health outcomes and reduced absenteeism. Biophilic design and access to natural elements are also frequently cited as spatial elements that enhance cognitive function and reduce fatigue (Zhang, Yu, Hou, Shu, Bo, Shi & Nie, 2024).

Safety is a critical component of spatial layout, particularly in environments that accommodate large populations such as schools and corporate offices (Zallio & Clarkson, 2021). Poorly designed layouts can impede emergency egress, create blind spots, or increase the risk of falls, collisions, and ergonomic injuries (Vaarula, 2023). In educational facilities, spatial layout influences the ease of supervision, crowd control, and student mobility. Clear lines of sight, well-defined circulation paths, and secure entry/exit points are essential for ensuring safety, especially during emergencies such as fire drills or lockdowns (Key, 2021). In work environments, layout affects not only physical safety but also psychological security. Overcrowded or poorly lit workspaces can increase stress levels and reduce perceptions of safety and comfort (Ping, Majid & Madhumati, 2024). Organizations that prioritize spatial safety tend to experience higher morale and lower turnover (Slil, Iyiola, Alzubi & Aljuhmani, 2025).

Despite the breadth of research, several gaps remain. First, comparative studies that span both educational and workplace environments are limited, making it difficult to generalize findings across contexts. Second, many studies focus on subjective measures (e.g., satisfaction) without linking them to objective performance outcomes (e.g., test scores or productivity metrics). Third, cultural and contextual variations, especially in developing countries, are underrepresented in the literature, limiting the global applicability of prevailing design standards. Lastly, there is a need for longitudinal studies that track how spatial changes over time affect behavior, performance, and safety. Such studies would provide more robust evidence for the long-term benefits or drawbacks of particular layout strategies.

III. METHODOLOGY

This study adopted a systematic literature review (SLR) approach to collate, evaluate, and synthesize

existing research on the influence of spatial layout on learning outcomes, safety, and productivity in educational and work environments. To ensure relevance and rigor, a set of inclusion and exclusion criteria as shown in Table 1 was applied to journal articles, conference papers, and reputable reports published between 2010 and 2024 with contemporary relevance.

Table 1: Inclusion and Exclusion Criteria

Inclusion Criteria	Exclusion Criteria
Research focused on spatial design/layout in educational (primary to tertiary) and work environments.	Articles lacking empirical evidence or clear methodology.
Studies addressing learning outcomes, safety, and/or productivity.	Studies focused solely on virtual or digital environments.
Articles written in English.	Research unrelated to physical spatial layout (e.g., organizational culture, curriculum design).

Source: Author (2025)

The screening process followed the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines:

- Title and abstract screening: Articles were reviewed for relevance to the research questions and inclusion criteria.
- Full-text review: Eligible articles underwent detailed analysis to assess their methodological quality and thematic relevance.
- Data extraction: Key information from each study was recorded, including author(s), year, context (education/workplace), study design, spatial features examined, main findings, and limitations.

Ultimately, 15 articles met all criteria and were included in the final synthesis. The extracted data were analyzed using a thematic synthesis approach. This involved: Coding key findings from each article into thematic categories, Grouping themes based on the three focal outcomes: learning, safety, and productivity, Identifying patterns of convergence and divergence across contexts (educational vs. workplace), Mapping trends and

gaps, including commonly cited spatial features and their reported impacts.

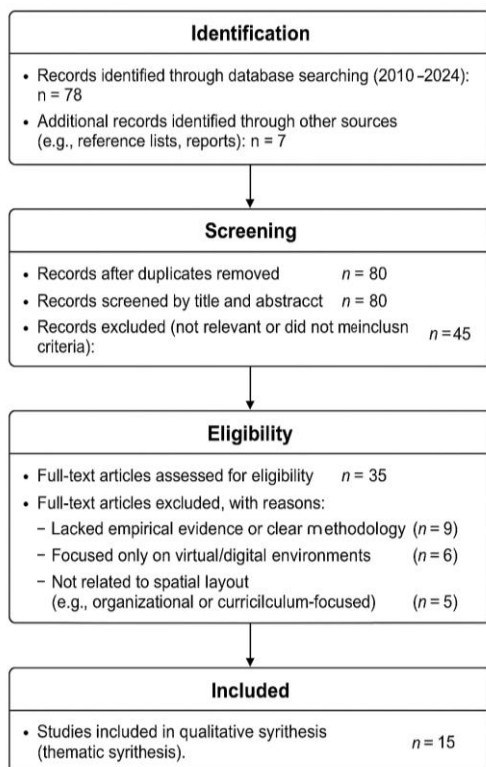


Figure 1: PRISMA diagram of study

Source: Author (2025)

To enhance validity and reliability, the study employed the following strategies: a pilot review of 10 randomly selected articles to test and refine the screening and coding framework, cross-validation of coding categories by a second reviewer to reduce subjectivity and use of standardized review protocols (PRISMA) to ensure transparency and replicability.

IV. RESULTS AND DISCUSSION

Table 2: Synthesis of literature

S/N	Author(s) & Year	Context	Study Design	Spatial Features Examined	Main Findings	Limitations
1	Azemati, Aminifar & Pourbagher (2018)	Educational, secondary schools, Iran	Mixed-method survey & correlational; n=310 teachers & students	Physical comfort, space layouts, psychological, visual factors	Comfort, flexible layouts, psychological support, and visual aspects significantly boost productivity and attendance	Localized Iranian sample; self-reported; cross-sectional
2	Hong, Kim & Yang (2022)	Educational, US university learning commons	Case study; mixed subjective surveys, objective IEQ measures	Noise levels, lighting, visibility, furniture styles	Good noise control improves individual work; visibility and open furnished zones enhance collaboration	Single-site; perceived productivity; limited generalizability
3	Agbozo, Owusu, Hoedofia & Atakorah (2017)	Workplace, Ghanaian banking sector	Survey with stratified sampling	Workspace design, ambiance, behavioral environment	Positive physical ambiance environments correlate with higher job satisfaction	Cross-sectional; one-sector sample; self-report
4	Bower, Dalgarno, Kennedy, Lee & Kenney (2015)	Educational, tertiary blended learning	Cross-case mixed methods; n=7 universities	Room configuration, tech layout, visual/audio, furniture	Blended spaces must balance tech access and seating for collaboration	Small expert sample; technology-specific
5	Hamed, Hussain, Jani, Sabri & Rusli (2023)	Workplace, employees in Malaysia	Analytical literature review/ content analysis	Physical workplace attributes tied to organizational culture	Workplace design aligned with culture boosts satisfaction, collaboration, productivity	Theoretical review; no original empirical data
6	Nja, Anari, Erim, et al. (2023)	Educational, presumably secondary/university	Empirical study; survey & mediational modeling	Physical, social & psychological mediators in student spaces	Well-designed spaces enhance collaboration, interest, educational outcomes	Context unclear; no geographic specification
7	Lebasi & Talischi (2024)	Educational, systematic review	Systematic literature review	Physical learning environments and creativity	Highlighted key environmental factors fostering creativity in education	Secondary review; limited empirical specificity
8	Ajala (2012)	Workplace, African context	Likely survey-based study	Ergonomics, lighting, space, welfare infrastructure	Positive environment factors associate with better welfare and productivity	Details limited; older study; broad scope
9	Al-Omari & Okasheh (2017)	Workplace, engineering company, Jordan	Case study; likely quantitative surveys	Office layout, facilities, ergonomics	Better work environments improve employee performance	Single company; limited generalizability
10	Leblebici (2012)	Workplace, Turkish bank	Case study; qualitative & quantitative	IEQ; lighting, noise, ventilation, furniture	Workplace quality directly influences employee performance	Single-sector; dated; cross-sectional

11	Pawirosumarto, Sarjana & Gunawan (2017)	Workplace, Indonesian hotel	Survey-based correlational study	Physical environment, leadership, culture	Work environment strongly influences job satisfaction and performance	Cross-sectional; cultural/context specificity
12	Dul & Ceylan (2011)	Workplace, creative industries	Ergonomic case studies; interviews	Physical layout for creativity; flexible spaces	Ergonomic designs facilitate creativity and idea sharing	Industrial-specific; qualitative; small sample
13	Barrett, Zhang, Moffat & Kobbacy (2013)	Educational, UK primary schools	Multi-level quantitative analysis	Classroom design: light, color, flexibility, layout	Classroom design correlates up to 16% variance in learning outcomes	UK-only; correlational design
14	Valtonen, et al. (2021)	Educational, Finnish universities	Survey & preference mapping	Informal, flexible learning spaces	Students prefer informal, flexible spaces for learning	Self-report; cultural specificity; early adoption bias
15	Bakó-Biró, Clements-Croome, Kochhar, Awbi & Williams (2012)	Educational, schools	Quantitative field study	Ventilation rates, CO ₂ levels	Better ventilation linked to improved cognitive performance	Field study; partial causality; context specific

Source: Author (2025)

A. Three-Part Outcomes: Learning, Safety, and Productivity

The reviewed literature consistently highlights that spatial layout exerts significant effects across three critical outcomes (learning, safety, and productivity) though emphasis varies by context. In educational settings, studies such as Azemati et al. (2018) and Barrett et al. (2013) revealed that optimized classroom design, through flexible furniture layouts, enhanced visual access, and ample natural light, boosts engagement, attendance, and academic performance. Hong et al. (2022) showed that in university learning commons, noise management and seating visibility were key determinants of both individual and collaborative productivity. While safety was less explicitly evaluated, ventilation studies (Bakó-Biró et al., 2012) indirectly tied improved air quality to better cognitive ability, hinting at an underlying safety-performance link.

In workplace environments, productivity and job satisfaction emerged as primary metrics. Agbozo et al. (2017), Leblebici (2012), Al-Omari & Okasheh (2017), and Pawirosumarto et al. (2017) all found

that ergonomic layout, lighting, and visual comfort markedly improve both satisfaction and performance. Dul & Ceylan (2011) and Hamed et al. (2023) emphasized creativity and collaboration enhancement through flexible, occupant-driven spatial arrangements. Safety was seldom directly measured, yet physical amenities, circulation ease, and facility quality in studies by Ajala (2012) and Al-Omari & Okasheh (2017) suggest a latent safety dimension that supports comfort and reduces workplace hazards.

B. Patterns of Convergence and Divergence across Contexts

Convergence across educational and workplace settings emerges strongly around some shared spatial features: flexibility, environmental quality, and occupant control. Azemati et al. (2018) and Dul & Ceylan (2011) both advocate for adaptable furniture and user agency in organizing space, whether for learning or creative work. Visual and acoustic comfort, highlighted in Barrett et al. (2013) and Leblebici (2012), prove to be universally significant. Enhanced contact with daylight, reduced noise, ergonomic considerations,

and support for interaction feature prominently in both contexts.

A key divergence is the degree to which specific spatial elements are prioritized: educational studies place greater weight on seating configurations that support interaction and flexible pedagogical forms (Barrett et al., 2013; Valtonen et al., 2021). Workplace research, however, emphasizes permanent infrastructure elements (lighting, ventilation, and thermally controlled environments) crucial for sustained employee wellness and productivity (Leblebici, 2012; Hamed et al., 2023). Additionally, while educational investigations more often link spatial layout to cognitive and social outcomes, workplace studies tend to focus on satisfaction and overall performance.

C. Trends and Gaps in Spatial Features and Their Reported Impacts

Trends identified across the literature include:

- i. Flexibility & user adaptability: Multiple studies (Azemati et al., 2018; Dul & Ceylan, 2011) emphasize mobile furniture and space customization as key to both engagement and creativity.
- ii. Environmental quality: Natural daylight, acoustics, ventilation emerge repeatedly across education (Hong et al., 2022; Bakó-Biró et al., 2012) and workplace studies (Leblebici, 2012; Agbozo et al., 2017), underscoring their role in performance and cognitive function.
- iii. Visibility and circulation: Openness and connectivity, especially in collaborative zones, are shown to enhance interaction and perceived productivity (Hong et al., 2022; Dul & Ceylan, 2011).

Following these trends, some gaps remain apparent. Safety as a discrete variable is largely underrepresented, most studies merely infer safety benefits without measuring injury rates, accident frequency, or evacuation efficiency. Longitudinal insights are scarce; cross-sectional designs dominate, limiting understanding of how spatial interventions impact outcomes over time. Generalisability is constrained by locale-specific samples, many studies focus on singular institutions or nations (e.g., Iran, Finland, Ghana, Jordan). Objective performance measures are less prevalent than subjective self-reports. Aside from Bakó-Biró et al.'s (2012) field measurements, few

studies combine behavioral or cognitive tests with self-assessments. Integrative designs that holistically link learning, safety, and productivity via spatial features are rare, inhibiting comprehensive design frameworks for multi-purpose environments. The discussion highlights a clear interplay between spatial layout and human-centric outcomes across educational and workplace settings. While flexibility, environmental quality, and visibility consistently enhance learning and productivity, safety remains an underexplored dimension. Future research would benefit from integrated longitudinal studies, objective measures, and cross-cultural comparisons designed to capture nuanced interactions between physical space and performance outcomes.

V. CONCLUSION AND RECOMMENDATIONS

This systematic literature review has provided a comprehensive synthesis of existing research on the impact of spatial layout on three key human-centered outcomes: learning, safety, and productivity, within both educational and workplace environments. Across the 15 reviewed studies, evidence consistently affirms that spatial arrangements, ranging from physical comfort and environmental quality to the flexibility of layout and circulation, play a significant role in shaping user experience, performance, and well-being. In educational settings, spatial configurations that promote flexibility, natural light, acoustic balance, and visual openness are closely associated with improved cognitive engagement, collaborative learning, and academic achievement. Similarly, in workplace contexts, ergonomic layouts, air quality, lighting, and user control over spatial arrangements are strongly linked to job satisfaction, reduced stress, and enhanced employee output. Although safety was not always directly measured, its presence is implied through features that support comfort, accessibility, and clarity of movement within space.

Despite the convergence of findings across contexts, the review also reveals key divergences and research gaps. Educational studies tend to focus more on social and psychological impacts of space, while workplace research emphasizes environmental control and infrastructure quality. A notable shortcoming across both domains is the

lack of explicit emphasis on spatial safety as a measurable variable, as well as the scarcity of longitudinal and cross-cultural studies that would allow for generalization and deeper causal insight. In light of these findings, the following recommendations are offered:

- i. Adopt a holistic design approach that simultaneously considers learning, safety, and productivity as interdependent outcomes of spatial planning, rather than treating them as isolated metrics.
- ii. Integrate flexibility and user control into space design. Modular furniture, reconfigurable layouts, and multi-purpose zones should be prioritized in both classrooms and work environments to accommodate varying user needs and promote autonomy.
- iii. Enhance environmental quality through layout, by maximizing access to natural light and ventilation, minimizing noise intrusion, and ensuring visual connectivity across spaces. These features not only support comfort but are also linked to measurable improvements in cognitive and task performance.
- iv. Prioritize safety as an active design dimension, not a secondary concern. Circulation routes, visibility, emergency access, and ergonomic risks should be incorporated into initial space planning and periodically reassessed for functionality.
- v. Promote evidence-based design through data-driven assessments, combining subjective feedback with objective performance metrics (e.g., test scores, output levels, health indicators). Designers and facility managers should be equipped to evaluate spatial interventions beyond aesthetics.
- vi. Encourage participatory design processes, involving end users (students, educators, employees) in layout decisions. Their insights can reveal context-specific spatial needs and help shape environments that are more inclusive, efficient, and user-responsive.
- vii. Support future research with longitudinal, comparative studies across different geographic and cultural contexts. Such research would improve generalizability and offer more nuanced understanding of

how spatial layout impacts human outcomes over time.

In conclusion, the spatial layout of built environments is far more than a backdrop to human activity; it is an active agent shaping how people learn, work, interact, and thrive.

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