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ORIGINAL

# Designing spaces for learning: the role of architecture in education

## Diseñando espacios para el aprendizaje: el rol de la arquitectura en la educación

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**ABSTRACT**

**Introduction:** the article explores and synthesizes architectural design in educational environments, academic performance and the well-being of students and teachers, through which it seeks to offer a guide for future implementations that improve educational processes through the conscious design of spaces.
**Method:** the research is carried out through a narrative review, which includes: Exhaustive search of scientific literature. Use of databases such as Google Scholar, Dialnet and Scielo with key terms related to the educational influence of architecture. Selection of 6 relevant articles, eliminating duplicates and those that did not meet the established criteria.
**Results:** six relevant articles were identified that address different aspects of the influence of architecture on education, highlighting the importance of aspects such as natural lighting, acoustics, ventilation and furniture design. These elements are key to creating an effective and positive learning environment.
**Conclusions**: architectural spaces can influence academic performance, student and teacher behavior, as well as creative and critical development. Pedagogical proposals such as Escuela Nueva, the Montessori method and the Waldorf philosophy highlight the need to create flexible spaces in harmony with nature. Smaller, well-located schools can provide more conducive learning environments and improve teacher attitudes. Structural improvements and innovative architectural design can raise the quality of teaching; however, careful resource planning is needed to measure their effectiveness.

**Keywords:** Space Design; Learning Spaces; Architecture; Education.

**RESUMEN**

**Introducción:** el artículo explorar y sintetiza el diseño arquitectónico en los entornos educativos, el rendimiento académico y el bienestar de estudiantes y docentes, a través del cual se busca ofrecer una guía para futuras implementaciones que mejoren los procesos educativos a través del diseño consciente de espacios.
**Método:** la investigación se lleva a cabo a través de una revisión narrativa, que incluye: Búsqueda exhaustiva de literatura científica. Uso de bases de datos como Google Académico, Dialnet y Scielo con términos clave relacionados con la influencia educativa de la arquitectura. Selección de 6 artículos relevantes, eliminando duplicados y aquellos que no cumplían los criterios establecidos.
**Resultados:** se identificaron 6 artículos relevantes que abordan diferentes aspectos de la influencia de la arquitectura en la educación, destacando la importancia de aspectos como la iluminación natural, la acústica, la ventilación y el diseño de muebles. Estos elementos son clave para crear un ambiente de aprendizaje efectivo y positivo.
**Conclusiones:** los espacios arquitectónicos pueden influir en el rendimiento académico, el comportamiento de estudiantes y docentes, así como en el desarrollo creativo y crítico. Propuestas pedagógicas como la Escuela Nueva, el método Montessori y la filosofía Waldorf resaltan la necesidad de crear espacios flexibles y en armonía con la naturaleza. Las escuelas más pequeñas y bien ubicadas pueden proporcionar entornos más favorables para el aprendizaje y mejorar las actitudes de los docentes. Mejoras estructurales y un diseño arquitectónico innovador pueden elevar la calidad de la enseñanza; sin embargo, se necesita una planificación cuidadosa sobre recursos para medir su efectividad.

**Palabras clave:** Diseño de Espacios; Espacios para el Aprendizaje; Arquitectura; Educación.

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## INTRODUCTION

Traditionally conceived as the art and science of designing and constructing buildings, architecture has a much more profound impact than is commonly perceived, especially in the educational context. Historically, academic institutions have focused primarily on pedagogical content and teaching methods without fully considering the physical environment in which these processes occur. However, it is now recognized that the architectural design of educational spaces plays a fundamental role in the teaching and learning process. As Scanavino[1] points out, architecture must evolve hand in hand with changes in pedagogical guidelines and teaching methods, adapting to new educational, technological, and social demands. Architecture is not limited to creating functional spaces but must actively contribute to creating environments that foster learning and the comprehensive development of students.

Architectural design directly impacts various aspects of student's academic performance and psychological well-being. As Vidal Rojas[2] states, good architectural design improves the quality of education provided in spaces, as it influences how students interact with their environment and how they feel about it. In this sense, educational architecture is about building classrooms and creating environments that facilitate concentration, collaboration, creativity, and critical thinking. As academic institutions seek to prepare students to face the challenges of an increasingly complex and technological world, the design of spaces must adapt to new pedagogical approaches that promote active, collaborative, and inclusive learning.

Recent research has shown that the design of educational spaces affects fundamental aspects of the educational process, from student concentration to their physical and emotional health. According to Amoroso Inga[3], the interior design of classrooms and other academic spaces directly impacts student education. Factors such as natural lighting, acoustic quality, adequate ventilation, and furniture ergonomics are crucial elements that can enhance or hinder a conducive learning environment. A well-lit, adequately ventilated, and acoustically controlled environment can facilitate concentration and reduce fatigue, while ergonomic furniture contributes to students' and teachers' comfort and physical well-being.

In addition, the integration of green spaces and areas for recreation and socialization is becoming a growing trend in the design of educational spaces. These elements contribute to physical and emotional well-being and foster a holistic education that supports students' academic, social, and emotional development. Natural environments and spaces designed for rest and social interaction have been shown to improve mood, reduce stress, and promote community, fostering a more positive and productive educational environment.

In this context, the narrative review entitled "The Role of Architecture in Education" explores how the design of educational environments can influence students' academic performance and overall well-being. This review seeks to identify and synthesize relevant studies that address everything from theoretical perspectives to practical architecture applications in educational environments. Through a comprehensive review of the literature and analysis of innovative case studies from schools and universities worldwide, the aim is to highlight the importance of architectural design in education.

The cases studied will include examples of cutting-edge designs that have been successfully implemented in different contexts, showing how architecture can be used strategically to respond to students' pedagogical and emotional needs. Projects integrating sustainable solutions, flexible spaces, collaborative learning environments, and including natural elements within designs will be analyzed. In addition, innovative approaches such as biophilic design, which promotes connection with nature within educational environments, will be addressed.

This work aims to highlight the importance of architecture in education and offer practical guidance for future educational space design projects. As institutions seek to adapt to new pedagogical realities, architectural decisions play a crucial role in creating environments that foster effective learning and students' overall well-being, preparing future generations to face the challenges of a constantly changing world.

## METHOD

To conduct this review, an exhaustive search of scientific literature was conducted between November and December 2022, using recognized databases such as Google Scholar, Dialnet, Scielo, and international repositories. The most frequently used terms were "Architecture in education," "Pedagogical spaces," "Educational facility design," OR "Learning environment." These terms were chosen to effectively capture the most relevant aspects of how architecture influences the educational environment.

The selection of articles focused on publications from 2020 to 2023, considering works written in any language and excluding manuscripts such as case reports, interviews, letters to the editor, theses, and books. Of the 22 articles initially identified, six were selected after eliminating duplicates and those that did not meet the objectives or inclusion criteria of the review.

This approach allowed us to synthesize the most recent and relevant research on architecture's influence in the educational field. We will analyze innovative cases and progressive designs that have been shown to improve the educational experience by optimizing the physical environment. This work seeks to highlight the importance of architecture in education and offer guidelines for future implementations that can enrich the educational process through the conscious design of spaces.

## RESULTS

The review identified six articles in the various databases mentioned above, with the Dialnet database, Scielo, and international repositories standing out as the primary sources, with six articles (figure 1).

The educational influence of architecture can also be expressed as the pedagogical impact of built environments. It is assumed that the nature of school buildings considerably impacts student learning and teaching techniques.[4] This proposal was appreciated by eminent teachers throughout history, such as Fröbel, whose architectural method still resonates in many contemporary kindergartens.[5]

| Título del estudio | Objetivo / Muestra | Principales resultados |
|---|---|---|
| Arquitectura y Educación. Una hermenéutica de los espacios en clave pedagógica (Sanchez, et al., 2020) | Explorar cómo los espacios educativos afectan el aprendizaje y la enseñanza, tanto desde una perspectiva histórica como teórica. | Los espacios educativos son cruciales como recursos pedagógicos que influyen significativamente en qué y cómo aprenden los sujetos. La interpretación de estos espacios a través de una lente hermenéutica revela tanto oportunidades como riesgos asociados con la validez y objetividad del enfoque. |
| Educación en arquitectura: transiciones hacia el desarrollo sostenible (Castellanos, 2020). | Analizar tres aspectos de la Educación en Arquitectura: el desarrollo social de la cultura occidental desde el punto de vista ambiental, la evolución de la educación en occidente desde las primeras teorías modernas, y la formación en Arquitectura desde una perspectiva histórica y epistemológica. | Se identifican puntos de convergencia entre el desarrollo social, educativo y disciplinar en Arquitectura. Se destaca la importancia de integrar la sostenibilidad y el pensamiento crítico en la enseñanza de la Arquitectura, reconociendo los desafíos de divergencia entre estos aspectos críticos. |
| Una revisión crítica en la enseñanza universitaria de la arquitectura. El caso de la UNAM, México y la UNCUYO, Argentina (Miranda, 2021). | Analizar la enseñanza de la arquitectura en las universidades de América Latina, específicamente en la UNAM en México y la UNCUYO en Argentina, con un enfoque en la perspectiva socio-crítica para entender el diseño metodológico y el abordaje ontológico-epistemológico. | Se destacan las propuestas pedagógicas de ambas instituciones que abordan de manera integral el tema del hábitat humano desde la arquitectura, destacando un proceso dialéctico entre las necesidades de la gente y la configuración de los territorios. |
| Influencia del color del aula en los resultados de aprendizaje en 3° año básico: estudio comparativo en un colegio particular subvencionado en Santiago de Chile (Rojas, 2020). | Se buscó analizar cómo la iluminación natural y artificial, así como la distribución del color en el ambiente escolar, afectan el rendimiento académico y el bienestar de los estudiantes en el aula | Resaltan la importancia de considerar el diseño y la ambientación del aula como un factor relevante en el proceso de enseñanza y aprendizaje, mostrando cómo pequeños cambios en el entorno físico pueden tener un impacto significativo en los resultados educativos y en la experiencia de los estudiantes. |
| Diseño interior de aulas psicopedagógicas para niños, adolescentes y adultos jóvenes (Inga, 2023) | El objetivo del estudio es analizar la influencia de la cultura organizativa en el desenganche escolar de los estudiantes en las Aulas | Los principales resultados del estudio revelan que la cultura organizativa de los centros escolares y las Aulas Ocupacionales influye significativamente en el desenganche escolar de los estudiantes |

**Figure 1.** Characteristics of selected articles

For centuries, the factory structural model has been dominant.[4] Like an assembly line, students move from classroom to classroom according to the subject or course. Despite constructivist theories suggesting otherwise, teachers transfer knowledge to them and then send them to another classroom, where the cycle continues. This sequence creates monotonous and predictable learning and school life. However, it is crucial to recognize the fallacy of speaking of certainty in pedagogy, especially from critical approaches.

McLaren[6] argues that students are not ethereal entities that runners must drag through pedagogical rhetoric and sophistry; instead, they are complex historical actors who must interpret their existence's various texts. The opportunities for training are numerous. The uncertainty principle applies, empowering people to navigate the ocean of uncertainty in which they find themselves in.[7] This situation establishes structural and organizational barriers within the school for any teacher or student who attempts to deviate from the conventional model, thus highlighting an apparent lack of alternatives for educational innovation.

According to Lee et al.[8], the social structure of an educational institution is affected by its architecture, which impacts personal interactions and, consequently, the social growth of students. The level of interaction between individuals is closely linked to the distribution and use of spaces. Numerous contemporary authors have addressed structuring educational spaces with a clear pedagogical orientation. Among them, the work of Dutch designer Rosan Bosch stands out, recognized for her innovation in this field. Her initiatives, focused on removing physical barriers and creating open spaces, highlight the importance of linking the physical environment with pedagogical methodology, suggesting a modification of the former to promote the latter.[9]

Tanner[10] highlights particular aspects that significantly impact teaching practices, which in turn affect student performance, teacher behavior, the emergence of conflicts, and creative or critical growth. According to Tanner, these elements focus on the movement and circulation of people within the school environment, the importance of lighting, and its impact on the center's life. Outdoor corridors are a clear example of this, as they play a crucial role in people's interaction with buildings, offering freedom of movement and orientation through signage inside and outside the structures. On the other hand, interior corridors should avoid excessive use, since the use of public rooms and common areas for movement and gathering, creating a circuit that runs through different spaces can be highly beneficial. These public areas promote a sense of community that can be extremely beneficial. An auditorium or dining hall managed properly, can generate a strong sense of unity and interpersonal connection.[11]

Thornburg[12] points out four ideal spaces for schools from an architectural and pedagogical perspective. These spaces are intended for different activities: the "Campfire space" for shared reading, the "Watering Holes" for debates, the "Caves" for reflection, and the "Life spaces" for discussions among students. These spatial modifications do not require significant investments and could be carried out on a shoestring budget.

Outdoor spaces also play a crucial role in the educational environment. These areas, defined as learning zones, can be located between and around buildings and include elements such as trees, hedges, fences, fields, arcades, or walkways.[10] Dewey already emphasized the importance of large grounds, gardens, and greenhouses, highlighting the value of the outdoors.

In particular, it has been observed that both school size and classroom size affect academic performance. Contrary to the common belief that a larger school leads to better results and a school climate more conducive to innovation, the study by Lee et al.[8] reveals the opposite. These authors point out that smaller schools provide more favorable educational environments for student learning and improve teachers' attitudes toward their students. According to their research, teachers in smaller schools take greater personal responsibility for their student's learning process than those in larger schools. They also conclude that school size influences learning directly and indirectly by influencing attitudes that, in turn, impact students, teachers, and the educational process. Furthermore, the impact of size is not limited to academic performance; as Lee et al.[8] point out in their study on school dropout rates, it can also affect school dropout rates.

Regarding allocating resources for structural improvement or innovative construction of educational facilities, the question arises as to whether this can improve the quality of teaching and academic performance. However, it is essential to establish when and where resources should be used most effectively. Furthermore, the problem is complicated because the results of investment in architectural aspects, such as the renovation of existing schools or the construction of new facilities, are challenging to measure in the short term. It is not easy to correlate these reforms with student performance. However, there are clear cases of wasteful spending, both in the failure to renovate old schools and in the unnecessary and ill-considered allocation of resources that do not address fundamental problems.

Temperature, air conditioning, and air quality are elements that have a significant impact on the everyday experience in educational establishments.[11] Therefore, architects responsible for designing a school must carefully consider the classroom's openness to the outside. A classroom cannot be limited to a rectangular space with a door, several windows on one side, and school furniture. It must be a welcoming, comfortable, and warm environment. In this context, light plays a crucial role. Adequate lighting is essential to foster an environment conducive to sound and efficient intellectual activity and regulate and coordinate human biological rhythms. Educational establishments have two lighting options: artificial light provided by electrical systems, such as lamps and desk lamps, and natural sunlight. According to Tanner[10] natural lighting is more advantageous. It is, therefore, crucial to orient classrooms towards the south to allow natural light to enter through windows, skylights, or glass panels. In addition to location, the design of these openings is also crucial. For example, in schools in Reggio Emilia (Italy), as Tarr[13] points out, the pedagogical capacity of the physical environment and its lighting are meticulously evaluated.

Furthermore, we must consider the role of color in the educational environment. Color is a stimulant for people, both students and teachers. It can foster creativity and has been proven to have an intimate link with concentration.[11] Therefore, it is crucial that the natural light entering through the windows and the colors used in the classroom are carefully selected so that these factors do not counteract each other but are used together to create optimal working environments.

**Architectural design as an educational tool**

Students relate to each other and share experiences in a community, interacting through communication. In this context, the educational space becomes a fundamental pedagogical resource. Individuals identify indirectly with their educational environment. Therefore, creating spaces where students and the community feel connected is possible, thus providing a moral and political

reference point.[6] This approach promotes active and democratic participation, where space and architecture are integral to teaching and learning.

From the perspective of the active school, Durá[14] states that this trend perceives school buildings as meeting children's physical and emotional demands and creating a pleasant environment that fosters learning. This liberal, rationalist, and regenerationist trend arrived in Spain from Germany, directly influencing pedagogical renewal. Sanz del Río played a fundamental role in introducing Krausist ideas to Spain, which provided a solid foundation for developing a new philosophy adapted to the characteristics and social needs of the country.[15] In addition, the Waldorf methodology emerged in Germany in 1919, inspired by Rudolf Steiner[16], whose architecture is characterized by creating warm, balanced environments free from rigidity and monotony.

The Montessori method introduces innovations in several aspects, especially regarding space design, as it requires more significant interaction between students. This interaction is encouraged in the classroom, a covered space, and in the playground, a semi-covered or open-air space. In this sense, Montessori architecture shares similarities with the Waldorf methodology, as both prioritize spaces for student interaction and Fröebel's pedagogy, which emphasizes the importance of outdoor spaces. Montessori uses space creatively, creating sub-spaces within the classroom to generate different environments. In fact, in today's Montessori centers, more modern interpretations of classroom design, such as the L-shape, promote a "collective intimacy" that stimulates socialization, development, and creativity. This proposal, located on the ground floor with access to the garden, promotes interaction with an essential space: nature, which is essential for the progress of the Active School method.[14]

**School architecture as a pedagogical interpretation of physical environments**

Social sciences, particularly pedagogy, are inherently linked to their temporal, spatial, and cultural context, making it difficult to establish absolute truths and bring them closer to contextualized interpretations. In this context, hermeneutics, understood as the theory and practice of interpretation, plays a relevant role in modern theory and methodology.[17] This vision involves interpreting educational practice through the theoretical discourse of education, focusing on human learning from a theoretical and practical perspective.[18]

Ricoeur[19] the concept of hermeneutics expands to include text and physical space, encompassing written and oral texts, practices, images, and sites. According to Salgado[20], school spaces are essential in curriculum design as they significantly impact instruction. In the educational process, space is presented as an interrelationship of spatial, social, and cultural structures that influence the personal development of individuals.[21] Several authors have pointed out the lack of attention paid to the space and location of schools from a pedagogical perspective. This study examines school architecture from an interpretive approach, which seeks to understand human action by interpreting its reasons. Barbera et al.[22] highlight phenomenology and hermeneutics as theories that adopt this approach to understanding social phenomena. Hermeneutics, in particular, seeks to understand the phenomenon in its entirety without fixing the facts and allowing multiple interpretations, which enriches the understanding of the constructs studied in the social sciences.

In this narrative, language and lived experience play a central role, giving rise to a hermeneutic interpretation that values subjectivity[23] and translates into a life experience. Physical spaces, such as environments of interaction and experience, are objects of analysis, given that we find ourselves in them and give meaning to our emotions, interactions, and human communication through them.[21]

In the educational field, various variables, actors, and tools influence the educational process, such as archival documents, interpersonal relationships, cultural traditions, emotional variables, and, of course, educational spaces, which can be conceived as a text or an educational language[21] that the reader, interpreter, or hermeneutics can decipher. This gives rise to the notion of a hermeneutics of spaces, which transcends symbolic production (images, icons, representations, behaviors) and the physical containment of individuals. From this comprehensive perspective, it is recognized that educational spaces must be analyzed considering all dimensions of the human being, society, culture, and history.[22,23,24,25,26]

From a pedagogical and hermeneutic perspective, we believe that everything can be coded. Even pedagogical spaces can be configured as text or pedagogical language, where the reader/interpreter must understand the educational meanings, actions, influences, and relationships through the decoding/recoding of the meanings and senses present in educational spaces.[27,28,29,30,31]

## CONCLUSIONS

Architectural spaces significantly influence teaching and learning processes, impacting academic performance, student and teacher behavior, and creative and critical development. Elements such as circulation, lighting, classroom size, and the availability of common areas play a crucial role in the educational experience.

Innovative pedagogical approaches, such as the Escuela Nueva, the Montessori method, and the Waldorf philosophy, have highlighted the importance of creating flexible, multipurpose spaces that are in harmony with nature. These architectural proposals seek to meet students' physical and emotional needs, fostering interaction, creativity, and comprehensive development.

The size and location of educational centers are crucial factors that must be carefully considered. Studies suggest smaller schools provide more favorable learning environments and improve teachers' attitudes toward students. In addition, location in noisy urban areas can lead to high blood pressure and hinder academic concentration.

Investment in structural improvements and innovative construction of educational centers can contribute to higher-quality teaching and academic performance. However, it is essential to determine when and where resources should be used most effectively, as the results of these investments are difficult to measure in the short term. A balanced approach must consider investment in human and material resources and architectural aspects.

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## CONFLICT OF INTEREST
Authors declare that there is no conflict of interest.

## AUTHORSHIP CONTRIBUTION
*Conceptualization:* Juan Alberto Almirón Cuentas, David Hugo Bernedo-Moreira.
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