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Learning spaces in schools: a pedagogic research agenda

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ABSTRACT

In this paper, we examine the resurgence of research on the relationships between pedagogy and physical learning environments in schools over the past twenty years and propose a research agenda to further advance the field. Acknowledging the field's evolution from earlier studies in the 1960s and 1970s to its current state, we identify two main research areas: the design of learning spaces and the pedagogical use of learning spaces, emphasising their interconnectedness. Recent studies have focused on flexible and innovative learning environments, spatial literacy and competency, and the alignment of pedagogy, physical space, and educational technology. Our proposed research agenda emphasises maximising pedagogical opportunities in learning spaces, exploring how environments can support pedagogical and technological progress, and investigating the impact of emerging technologies, including AI. Throughout, we stress the importance of interdisciplinary collaboration in creating effective learning environments that respond to evolving educational needs and technological advancements. We also highlight the need to address issues of diversity and inclusion, well-being, community use, and varied stakeholder perspectives.

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Learning spaces; pedagogy; school design; spatial literacy; spatial competency; research agenda

Introduction

The link between pedagogy and physical space in schools has become an increasingly important area of research over the past 20 years. A PhD dissertation by Kenn Fisher (Fisher, 2002) played a pivotal role in revitalizing this field of inquiry. Renewed interest in physical learning environments follows a previous period of extensive research undertaken in the late 1960s and 1970s, including studies related to the open-plan school movement conducted by the Educational Facilities Laboratories in the United States (Marks, 2009).

In recent years, a field of research focused on learning spaces has re-emerged, supported by several research groups. Key contributors include the OECD Centre for Effective Learning Environments (CELE) (e.g. OECD, 2011, 2017), the Research Institute for the Built and Human Environment at Salford University (e.g. Barrett et al., 2015), and the Learning

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Environments Applied Research Network (LEaRN) at the University of Melbourne (e.g. Cleveland & Fisher, 2014; Imms & Mahat, 2022), with which the authors are affiliated. Based on the authors' observations, this paper offers a commentary on developments in the field over the past 20 years and proposes a pedagogically oriented research agenda for future studies on learning spaces. While somewhat Australian-centric, the paper also references international research.

Interdisciplinary research over the past 20 years by academics in education and architecture has highlighted a shared interest in two main areas: a) designing learning spaces and b) the pedagogical use of learning spaces. It is important to recognize that these areas are closely linked; effective learning spaces are shaped not only by their design but also by how teachers and students perceive and use their spatial affordances (Gibson, 1979). Indeed, Gislason (2010) noted that "facilities design, educational practice, school culture, and student learning are . . . interrelated aspects of a school's total learning environment" (p. 127).

Pedagogically related studies have often focused on designing flexible and innovative learning environments and how teachers and students adapt to these new spaces. Such studies often evaluate the value of learning environments for teaching and learning practices (e.g. Byers et al., 2018). Research has also examined teachers' and students' spatial literacy, spatial competency, and collaborative and inclusive methods to engage students. Throughout this development, key differences have emerged from earlier ideas and research, leading to new insights into how pedagogy, physical space, and educational technology can be effectively aligned. As key concepts and shared terminology have developed, researchers have been able to communicate their work more clearly. Additionally, disciplines such as environmental psychology have provided useful theories and methods to support deeper investigations into the pedagogical relationships teachers and students have with their physical and technological surroundings.

However, further research is needed to guide the design of schools and the pedagogical use of learning spaces in the future. As Radcliffe's (2009) Pedagogy-Space-Technology (PST) Framework for Designing and Evaluating Learning Spaces indicates, there is a requirement for studies that explore the most effective ways for learning environments to support pedagogical and technological progress. As pedagogies and educational technologies develop in schools, including those influenced by artificial intelligence (AI), it remains important to examine the interconnected relationships between pedagogy, space, and technology in shaping teachers' practices and students' learning experiences.

Focusing on student-centred pedagogies, Radcliffe (2009) developed the PST framework to guide the design of contemporary learning spaces. He emphasized the importance of selecting spatial and technological elements driven by pedagogical needs and aligned with desired teaching and learning behaviours, rather than simply replicating traditional classroom models. His motivation stemmed from the belief that educators, architects, and technologists need to collaborate to create engaging and effective learning environments.

This paper explores recent developments in school design and spatial use, emphasizing the need to maximize the pedagogical opportunities of learning spaces. After reflecting on the current state of the field, we suggest a research agenda that emphasizes pedagogy in physical learning spaces, aligning with the motivations outlined by Radcliffe

(2009), 15 years ago. The paper is organized into three main sections: school design, spatial use, and a pedagogical research agenda for learning spaces in schools. Recognizing the PST framework, we see technology as closely linked to these broader issues rather than as an isolated factor. Our research agenda can be advanced by scholars dedicated to enhancing effective teaching and learning in schools who view learning spaces and integrated technologies as crucial elements shaping the future of education.

School design: where are we?

Internationally, significant changes have taken place over the past 20 years in how learning spaces in schools are conceived and designed, reflecting evolving beliefs about what the physical environment should offer to teachers, students, and other users of school facilities. During the late 2000s and 2010s, schools with more open-plan designs, reminiscent of those from the 1970s, became fashionable again in various parts of the world, especially in Europe, Australia, New Zealand, parts of the United States, and international schools across Asia. An influential driver of this design trend was the OECD Centre for Effective Learning Environments, which promoted more flexible school layouts through their exemplary educational facilities design compendia (e.g. OECD, 2011) and related publications (e.g. Kuuskorpi & González, 2011). The OECD correctly argued that more contemporary school designs are needed to support pedagogical changes aligned with education provision for the 21st century.

In recent years, interest from academic scholars has prompted more detailed research focusing on the influence and impacts of school design characteristics on teachers and students (e.g. Barrett et al., 2015). With this evaluative approach and reflection, more sophisticated learning space designs have emerged across various parts of the world that better suit the needs and pedagogical preferences of school facility users. The growing adoption of strategic design thinking (Hill, 2012), which emphasizes the long-term goals of schools, has resulted in school designs that are more closely aligned with curricula, pedagogies, students' individual differences, teachers' workplace needs, and the requirements of wider community members who utilize school facilities for diverse purposes.

Recognition that school spaces must support evolving curricula has led to increased focus on the long-term design needs of both general-purpose and specialized school spaces, such as for science, technology, engineering, arts, and mathematics (STEAM). New educational technologies have driven change, requiring facilities that follow the principle "loose fit, long life" to accommodate the frequent updates of technological resources and related student activities. Over the past 20 years, desktop computers have been replaced by laptops, interactive whiteboards by digital screens connected to networked devices, 3D printers by more advanced fabrication technologies, and the list continues. Additionally, we are nearing a point where we need to respond to the rise of AI technologies in schools. The ongoing need for school interiors to adapt as curricula, technologies, and learning activities evolve remains a consistent theme that will persist.

Designing to support broader pedagogical repertoires has also been a key objective, while aiming to avoid overly simplistic open-plan designs that generally work counter to the provision of varied spatial options for students' activities due to noise distractions caused by others. Furthermore, studies of indoor environment quality (IEQ) in schools have contributed to a greater understanding of the importance of high-quality acoustic

conditions suited to learners' needs, along with other comfort-related factors such as lighting, air quality, and thermal comfort (e.g. Vijapur et al., 2021).

Pedagogical design now tends to focus on the proximities and relationships between complementary spaces, recognizing that large open rooms offer few distinct settings for varied activities. Classrooms supplemented by breakout areas that afford visual connection but are acoustically separate are increasingly being favoured and developed (Cleveland et al., 2018). These may include what are now commonly identified as innovative learning environments: dynamic, adaptable educational spaces designed to support diverse teaching and learning practices, fostering creativity, collaboration, and engagement (Mahat & Imms, 2021). These environments go beyond traditional classrooms to incorporate flexible and adaptable physical layouts, new technologies, and pedagogical approaches tailored to the evolving needs of learners. They challenge more traditional educational models to enable teachers to prepare learners for the complexities of the 21st century by aligning physical, psychosocial, digital, and pedagogical elements to create environments intended to inspire curiosity, creativity, communication, and lifelong learning.

Similarly, specialist facilities are increasingly being designed as clusters of spaces for related activities. For example, these may include settings to conceive, design, make, test, and redesign students' design technology projects. Pedagogically, this affords students the chance to express their agency as they move between specialized settings for different activities, while also helping to ensure their safety, especially when potentially dangerous equipment is involved in fabrication and manufacturing processes. For teachers, such arrangements assist in structuring learning activities around distinct settings, offering clear progression points as students work through design processes at different rates.

The growing demand for hybrid spaces in schools (Gil et al., 2022), where students can attend classes either in person or via video link, has led to the development of more technology-enabled environments over recent years. This trend has also prompted teachers to reconsider their pedagogical approaches to ensure students receive equitable experiences regardless of their mode of attendance. With the rapid expansion of hybrid learning spaces driven by the Covid-19 pandemic, the overall effectiveness of these environments is still evolving, particularly in terms of their design (including technological features) and the pedagogical practices needed to make them effective.

Changing views on supporting students with disabilities and trauma histories in mainstream schools are also influencing school design requirements. Inspired by European examples, education systems around the world are adopting inclusive education policies that encourage schools to welcome students of diverse abilities. As a result, traditional school layouts and features, originally designed for the "typical student", are being questioned (Cleveland et al., 2025; Tufvesson & Tufvesson, 2009). Supporting students and staff with a wide range of physical, cognitive, sensory, and/or emotional impairments, as well as refugees or displaced children who have experienced trauma (Duthilleul et al., 2021), presents particular challenges. Designing schools to accommodate this diversity is acknowledged as important, yet it remains an area that is still under-researched (Alterator et al., 2022).

With increasingly diverse roles to play in schools, teachers' expectations of their workplaces are also evolving. Beyond working with students in learning spaces, teachers are

seeking more professional work environments that support the various tasks they must perform. Little research exists on how to best physically accommodate teachers in schools, but workplace research from the commercial sector into activity-based workplace design is offering some insights (Candido et al., 2018).

Finally, school design is evolving to reflect changing views on what schools should provide for the broader community, including access to a variety of services and programmes or the use of educational spaces outside school hours. The development of schools with integrated or nearby early years education and family services is becoming more common as governments recognize the advantages of delivering services to families alongside schools (Lawson & van Veen, 2016). Schools as community hubs (Cleveland et al., 2023) are emerging as place-based responses to local community needs, helping to ensure community access to vital health and wellbeing services and programmes where they are most needed (Boys & Jeffery, 2023). This also includes offering sporting and recreational opportunities through schools' sports and performing arts facilities, often in collaboration with partner organizations. From a pedagogical standpoint, such shared use of school spaces contributes to important discussions about community education, especially regarding how schools can support community wellbeing and resilience through developing social and spatial capital (Mace, 2017).

Spatial use: actualising the benefits of new learning spaces

Changes in how school learning spaces are conceived and designed increase the need for teachers to have the knowledge and skills to use them effectively. Developing teachers' and students' spatial literacy (Fisher, 2002) and spatial competency (Lackney, 2008) is essential for the effective use of learning spaces, as this knowledge enables them to understand and optimize physical spaces for learning.

Spatial literacy refers to the ability to read, interpret, and analyse spatial information, such as layouts, maps, and the organization of physical spaces (Mulcahy et al., 2015). In schools, this includes understanding how the arrangement of spaces, furniture, technology, and students can affect teaching and learning practices and their outcomes. For example, a spatially literate teacher is more likely to recognize that flexible seating arrangements can encourage collaboration or that natural lighting boosts student focus and wellbeing.

Spatial competency is the practical application of spatial literacy. It involves making informed decisions to design, modify, or utilize learning spaces effectively (Mahat & Loh, 2024). Competent use of space considers diverse learner needs, such as creating quiet areas for reflection and emotional regulation, accessible layouts for students with disabilities, or interactive zones that encourage hands-on activities and collaboration. Together, spatial literacy and spatial competency empower teachers, students, and administrators to transform learning environments into dynamic, inclusive, and effective learning spaces. They ensure that the physical setting supports pedagogical goals, fosters engagement, and adapts to evolving educational practices, ultimately enhancing students' overall learning experiences.

Spatial literacy and spatial competency have appeared in teachers' professional learning and development programmes across various education systems internationally (Mahat et al., 2024). However, such opportunities for professional learning remain

infrequent, context-specific, and delivered "just in time", leading to localized knowledge confined to a few individuals (Mahat et al., 2024). Moreover, this type of professional learning is usually only available in schools and education systems with sufficient financial resources to support targeted teacher education. This raises concerns about access, equity, and how scalable suitable professional learning programmes are to ensure all teachers can attain and develop these skills.

Given the substantial investments in innovative school infrastructure worldwide, integrating spatial literacy and competency skills into teacher education programmes is crucial to ensure that new learning environments are used to their full pedagogical potential. We argue that teacher training focused on spatial knowledge and skills should begin during initial teacher education to prepare aspiring teachers with the necessary understanding, abilities, and experience to enter the profession confidently. Beginning teachers often lack adequate preparation to design curricula, develop teaching strategies, plan lessons, and implement behaviour management techniques that suit the diverse physical spaces available to them – especially in newer school facilities. By increasing their awareness of "space" as a significant tool they can utilize in their practice, enhanced socio-spatially responsive teaching practices can be expected.

Initial teacher education focused on the spatial aspects of the role is essential for preparing new teachers to create and optimize learning spaces. Spatial practice skills enhance teachers' ability to develop inclusive, adaptable, and responsive classroom climates. Subsequently, spatial competency empowers them to design and implement teaching strategies that align with the varied affordances of these environments, fostering more dynamic, student-centred learning experiences. Moreover, such skills may help teachers guide students in developing their own spatial reasoning skills. By embedding spatial literacy and spatial competency in teacher preparation programmes, we can help to ensure teachers are better equipped to maximize their impact on student learning and development.

Ideally, in-service teacher professional learning, the development of pedagogically responsive school-wide spatial practice norms, and the promotion of spatially aware instructional leadership should follow. A more structured approach to integrating spatial literacy and spatial competency into teachers' daily practices would help address what Fisher (2002) identified as the "spatial unconsciousness" of teachers. He suggested that teachers often use classrooms and other learning spaces in habitual ways, often overlooking how they could optimize these environments for different learning activities and underutilizing their full potential. He identified missed opportunities when teachers see learning spaces as fixed and rigid, rather than as opportunities to bring the curriculum and pedagogies to life and enhance student engagement.

Teachers trained in spatial literacy are also better equipped to create more inclusive learning environments. For example, they can design improved layouts and protocols to accommodate students with disabilities, such as by ensuring clear pathways for mobility aids or arranging distinct settings to support students with sensory sensitivities. Additionally, they can establish zones that cater to diverse learning styles, such as quiet areas for focused study, collaborative spaces for group work, and creative corners for hands-on activities. These inclusive practices promote equity, ensuring that all

students, regardless of their abilities, can fully participate in learning and school life (Alterator et al., 2022).

A crucial part of applying spatial competency is its role in resource optimization, allowing teachers to make the most of available spaces and resources. They can explore innovative ways to incorporate technology, such as mobile devices, interactive displays, virtual learning, and AI-assisted tools, while maintaining a practical and adaptable learning environment, even in constrained settings. By understanding spatial dynamics, teachers can turn limitations into opportunities for better learning experiences. This is particularly important as modern pedagogies increasingly focus on collaborative, experiential, and interdisciplinary learning supported by flexible and adaptable spaces. For example, project-based learning may require specific areas for large group brainstorming, while STEAM-making activities might need smaller, designated zones with particular tools and materials. Training teachers in these skills ensures they can grow with these practices and modify spaces to support innovative and modern educational methods.

By embedding spatial literacy and spatial competency into initial teacher education and ongoing professional learning programmes, we can better prepare teachers with the knowledge and skills to create environments that inspire, engage, and support all learners. This training not only improves the physical and functional aspects of school learning spaces but also enhances the overall teaching and learning experience, fostering environments where meaningful educational opportunities can flourish.

A pedagogic research agenda for learning spaces in schools

Advancing a pedagogic research agenda for school learning spaces is crucial for addressing the complex and changing demands of contemporary education. As schools worldwide strive to keep up with new educational expectations related to evolving curricula, pedagogies, technologies, perspectives on diversity and inclusion, and their relationships with the broader community, a comprehensive research agenda needs to offer evidence-based knowledge that can inform design choices and guide the innovative use of new learning environments in schools. Research must deliver current insights into solutions and practices that are both sustainable and adaptable. The suggested agenda, outlined below, is not exhaustive but offers a starting point for further exploration.

Shifting educational objectives

Aligning pedagogical, psychosocial, technological, and physical environments with evolving curricula will be vital if we are to effectively support the shifts in educational objectives currently being witnessed around the world. Shifts towards competency-based education and related assessment practices are prompting the reorganization of schools and transforming the functional needs of the spaces where students learn. Changing views on what is valued in education to include complex competencies, such as those outlined by the University of Melbourne's New Metrics team – acting ethically, active citizenship, agency in learning, communication, collaboration, and quality thinking (University of Melbourne, 2024) – challenge traditional pedagogies and question the suitability of the spaces that have long supported them. As curriculum designs develop to promote competency-based learning, what kinds of learning spaces are necessary to

support these curricula and educational objectives – both within schools and beyond, including in students' homes? We must explore what kinds of diverse environments can best support these changing educational objectives.

Diversity and inclusion

While Universal Design (UD) has highlighted the importance of creating learning spaces accessible to everyone, evidence on what works for students, teachers, and visitors to school campuses remains limited, particularly within mainstream education systems. Meeting the needs of diverse populations is challenging, requiring an understanding of the needs of people with disabilities, neurodivergent conditions, traumatic histories, varied cultural backgrounds, gender-specific requirements, and related considerations. In a post-Universal Design context (Guffey, 2021), the intersectionality of these needs must also be acknowledged. To deliver on the United Nations' Sustainable Development Goals of Good Health and Wellbeing (3) and Quality Education (4) (United Nations, 2025), schools must address these requirements. Further research is essential to better understand how all individuals can be supported to participate equitably in school education.

For example, the development of trauma-informed learning environments could be better aligned with trauma-informed pedagogies that include empathy, resilience-building, and restorative practices. By understanding the connection between trauma and learning, more supportive and inclusive practices and spaces are likely to be created. Understanding trauma's impact on learning involves exploring how trauma influences cognitive functions, emotional regulation, and social interactions in educational settings. By identifying the types of barriers faced by trauma-affected students in traditional education settings, stakeholders can become more skilled at designing spaces that provide a sense of calm and safety, such as through managing group sizes, noise, and lighting levels to better support students' self-regulation.

Designing with strategic purpose for learning, wellbeing, and community use

Too often, new schools are designed based on outdated specifications rather than current functional requirements that reflect modern and future operational and pedagogical practices. Further research is needed in school jurisdictions worldwide to ensure that historic views on what types of spaces are required in schools are not being imposed on today's schools, potentially hindering contemporary ways of working. More widespread adoption of strategic design thinking (Hill, 2012), with its emphasis on the long-term goals of schools, is essential to better align curricula, pedagogies, students' individual differences, teachers' workplace requirements, and the needs of members of the wider community who use school facilities for various reasons.

An example of evolving functional requirements includes the need for more substantial health and wellbeing-related spaces in schools. Partly driven by the aftermath of the Covid-19 pandemic, schools are aiming to accommodate increasingly larger numbers of wellbeing staff, such as counsellors, psychologists, and other support personnel, to address the mental and physical health needs of students (and staff). Research is required to determine how best to meet these needs, also exploring ways to ensure equitable and confidential access to health and wellbeing services.

Sustainability of alignments between pedagogy and space

To better understand the long-term suitability of different types of learning spaces, longitudinal studies should evaluate their effectiveness in promoting learning outcomes, including the complex competencies discussed earlier. This research should investigate how modern learning environments align with existing and future curricula, pedagogies, and assessment practices.

The importance of longitudinal studies prompts questions about the effectiveness of current methods for measuring learner competencies. While traditional assessments and new approaches each have benefits, their ability to comprehensively capture the full range of student skills often differs. More holistic ways of measuring student competencies should include multi-dimensional assessments that combine cognitive, emotional, and social aspects, and emphasize inclusive practices to ensure fairness and accessibility for all students. By improving how we measure student competencies, research on new learning environments can better align with holistic, future-oriented educational objectives.

Technology integration

In line with the shifts mentioned above, future research should investigate the potentially transformative effects of new technologies on the design and functionality of learning spaces, both in schools and beyond. Smart technologies, immersive augmented and virtual reality (AR/VR) systems, and AI-driven tools are all disrupting educational practices, presenting new opportunities and challenges for schools. What implications will the increasingly widespread distribution and adoption of these technologies have for pedagogies and learning spaces? What potential do these tools hold for fostering collaborative and personalized learning experiences? How might universally accessible learning environments be developed with inclusive and assistive devices to improve the participation of all learners?

Furthermore, the intersection of technology and ecological sustainability needs more investigation, especially the use of energy-efficient smart systems and data-driven space optimization strategies. This research aims to provide evidence-based insights to help develop future-ready learning environments that meet the changing needs of a technology-driven world and cater to students' personalized needs.

Varied stakeholder perspectives

Research is needed to explore the agendas outlined above from the varied perspectives of key stakeholders – especially from the perspectives of students. The diverse motivations of policymakers, government bureaucrats, school leaders, architects, builders, parents, and community members all influence the design and delivery of new learning spaces in schools – and subsequently affect the pedagogies implemented. Research that examines the different perspectives of these groups on school spaces is essential to understand whose interests are truly being served by new school designs. The perspectives of students are perhaps the least understood, and exploring their views on school design and spatial use could play a vital role in better aligning pedagogy, space and technology in future learning environments – both within schools and beyond.

Teacher spatial literacy and spatial competency

Although research into developing teachers' spatial literacy and competency exists, such as within the Innovative Learning Environments and Teacher Change (ILETC) project in Australia (Imms & Mahat, 2022), further geographically and culturally specific research is needed on how best to support teachers in recognizing and effectively using learning spaces (indoors and outdoors) in schools. The types of spaces available in schools worldwide vary greatly, influenced by local factors. Moreover, school systems and initial teacher training programmes operate in vastly different global contexts. More research is required across various countries on how to effectively engage teachers as spatially aware and capable professionals who can utilize both the physical and technological environment to benefit their students, helping to (re)shape pedagogical practices for the future.

Data collection methods innovation

Finally, school design and spatio-pedagogical research could benefit from adopting data collection techniques that surpass traditional interviews, focus groups, observations, and surveys. For example, using co-design tools that incorporate mixed reality (such as virtual reality and augmented reality) could allow users of school spaces to better contribute to their design and assessment before construction begins. This may help to better align the spaces with their functional needs. Similarly, technology-supported methods like geo-tracking, eye-tracking, and bio-emotional measurements could support innovative behaviour mapping studies and provide insights into how students and teachers emotionally respond to different spaces and environmental conditions. This can reveal which types of spaces are effective – or not – for various pedagogical approaches and user groups.

By exploring the intersections between pedagogy, space, and technology (Radcliffe, 2009), researchers can identify new strategies to improve teacher effectiveness, boost learner engagement and wellbeing, and ultimately optimize learning outcomes. We expect that pursuing this forward-thinking research agenda will provide researchers, educators, designers, and policymakers with the knowledge to develop effective, inclusive, and future-ready learning environments capable of inspiring and supporting meaningful educational experiences into the next decade and beyond. In an educational landscape anticipated to be heavily influenced by the growing use of AI-assisted teaching and learning tools, this agenda should focus on flexibility, adaptability, and connectivity while ensuring accessibility and equity for all teachers and learners.

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Disclosure statement

No potential conflict of interest was reported by the author(s).

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Marian Mahat is an Associate Professor at the Faculty of Education, University of Melbourne. She is a leading researcher in learning environments whose ongoing, influential work builds partnerships with government agencies, education departments, schools, and industry organizations. Her goal is to lead interdisciplinary, translational research that is embraced by education systems and schools, resulting in long-term improvements in student learning and outcomes. Marian's research focuses on critical issues at the intersection of physical and pedagogical learning environments, with particular emphasis on spatial literacy and competency, evidence-based teacher-initiated inquiry, and professional learning and development.

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References

Alterator, S., Cleveland, B., & Boys, J. (2022). The evaluation of inclusive school environments: A scoping review of the literature. *IUL Research*, *3*(6). https://doi.org/10.57568/iulres.v3i6.313

Barrett, P., Davies, F., Zhang, Y., & Barrett, L. (2015). The impact of classroom design on pupils' learning: Final results of a holistic, multi-level analysis. *Building & Environment*, *89*, 118–133. https://doi.org/10.1016/j.buildenv.2015.02.013

Boys, J., & Jeffery, A. (2023). Valuing urban schools as social infrastructure. In B. Cleveland, S. Backhouse, P. Chandler, I. McShane, J. M. Clinton, & C. Newton. *Schools as Community hubs*. Springer. https://doi.org/10.1007/978-981-19-9972-7_8

Byers, T., Imms, W., & Hartnell-Young, E. (2018). Evaluating teacher and student spatial transition from a traditional classroom to an innovative learning environment. *Studies in Educational Evaluation*, *58*, 156–166. https://doi.org/10.1016/j.stueduc.2018.07.004

Candido, C., Thomas, L., Haddad, S., Zhang, F., Mackey, M., & Ye, W. (2018). Designing activity-based workspaces: Satisfaction, productivity and physical activity. *Building Research & Information*, *47*(3), 275–289. https://doi.org/10.1080/09613218.2018.1476372

Cleveland, B., Backhouse, S., Chandler, P., McShane, I., Clinton, J. M., & Newton, C. (2023). *Schools as community hubs: Building "more than a school" for community benefit*. Springer.

Cleveland, B., & Fisher, K. (2014). The evaluation of physical learning environments: A critical review of the literature. *Learning Environments Research*, *17*(1). https://doi.org/10.1007/s10984-013-9149-3

Cleveland, B., Imms, C., Merrick, N., Imms, W., Aston, R., Candido, C., Tregloan, K., Clinton, J., Alterator, S., Loh, P., & Graham, L. (2025). Inclusive learning spaces in Australian schools: An exploration of stakeholder participation, perspectives and priorities. *International Journal of Inclusive Education*. https://doi.org/10.1080/13603116.2025.2553212

Cleveland, B., Soccio, P., Mountain, R., & Imms, W. (2018). *Learning environment design and use. Towards effective learning environments in Catholic schools (TELE): An evidence-based approach (2015-2017)*. Catholic Education Melbourne.

Duthilleul, Y., Woolner, P., & Whelan, A. (2021). *Constructing education: An opportunity not to be missed*. Thematic Reviews Series Council of Europe Development Bank.

Fisher, K. D. (2002). *Schools as' prisons of learning or, 'as a' pedagogy of architectural encounters': A manifesto for a critical psychosocial spatiality of learning* [Doctoral dissertation, Flinders University of South Australia, School of Education].

Gibson, J. J. (1979). *The ecological approach to visual perception*. Houghton-Mifflin.

Gil, E., Mor, Y., Dimitriadis, Y. A., & Köppe, C. (2022). *Hybrid learning spaces*. Springer.

Gislason, N. (2010). Architectural design and the learning environment: A framework for school design research. *Learning Environments Research*, *13*(2), 127–145. https://doi.org/10.1007/s10984-010-9071-x

Guffey, E. (2021). In the wake of universal design: Mapping the terrain. *Design Issues*, *37*(1), 76–82. https://doi.org/10.1162/desi_a_00629

Hill, D. (2012). *Dark matter and trojan horses: A strategic design vocabulary*. Strelka Press.

Imms, W., & Mahat, M. (2022). *Innovative learning environments and teacher change: Final research findings*. Innovative Learning Environments & Teacher Change, LEaRN, and the University of Melbourne. https://doi.org/10.46580/124366

Kuuskorpi, M., & González, N. C. (2011). The future of the physical learning environment: School facilities that support the user. In *Cele exchange, centre for effective learning environments, No. 2011/11*. OECD Publishing. https://doi.org/10.1787/5kg0lkz2d9f2-en

Lackney, J. A. (2008). Teacher environmental competence in elementary school environments. *Children, Youth and Environments*, *18*(2), 133–159. https://doi.org/10.1353/cye.2008.0007

Lawson, H. A., & van Veen, D. (2016). *Developing community schools, community learning centers, extended-service schools and multi-service schools. International exemplars for practice, policy and research*. Springer International Publishing Switzerland.

Mace, A. (2017). Spatial capital as a tool for planning practice. *Planning Theory*, *16*(2), 119–132. https://doi.org/10.1177/1473095215617000

Mahat, M., & Imms, W. (2021). Establishing a reliable measure of perceptions of teacher and student use of learning environments. *The Australian Educational Researcher*, *48*(1), 145–164. https://doi.org/10.1007/s13384-0020-00382-z

Mahat, M., Hurn, B., & Bradbeer, C. (2024). *Putting teachers' "spatial competency" on the professional learning map: An environmental scan*. The University of Melbourne. https://doi.org/10.26188/25963885

Mahat, M., & Loh, C. E. (2024). Teachers' changing perspectives of their spatial competencies: A case study of professional learning in Singapore. *Teaching and Teacher Education*, *152*(2024), 104797. https://doi.org/10.1016/j.tate.2024.104797

Marks, J. (2009). *A history of educational facilities laboratories (EFL)*. National Clearinghouse for Educational Facilities. https://files.eric.ed.gov/fulltext/ED508011.pdf

Mulcahy, D., Cleveland, B., & Aberton, H. (2015). Learning spaces and pedagogic change: Envisioned, enacted and experienced. *Pedagogy, Culture & Society*, *23*(4), 575–595. https://doi.org/10.1080/14681366.2015.1055128

OECD. (2017). *The OECD handbook for innovative learning environments*. Educational Research and Innovation, OECD Publishing. https://doi.org/10.1787/9789264277274-en

OECD. (2011). *Designing for education: Compendium of exemplary educational facilities 2011*. OECD Publishing. https://doi.org/10.1787/9789264112308-en

Radcliffe, D. F. (2009). A pedagogy-space-technology (PST) framework for designing and evaluating learning places. In D. Radcliffe, H. Wilson, D. Powell, & B. Tibbetts (Eds.), *Learning spaces in higher education: Positive outcomes by design* (pp. 11–16). University of Queensland.

Tufvesson, C., & Tufvesson, J. (2009). The building process as a tool towards an all-inclusive school. A Swedish example focusing on children with defined concentration difficulties such as ADHD, autism and Down's syndrome. *Journal of Housing and the Built Environment*, *24*(1), 47–66. https://doi.org/10.1007/s10901-008-9129-6

United Nations. (2025). *The sustainable development goals report 2025*. United Nations Statistics Division.

University of Melbourne. (2024). *New metrics: Transforming what we value in schools*. https://education.unimelb.edu.au/melbourne-assessment/our-research/new-metrics#home

Vijapur, D., Candido, C., Göçer, Ö., & Wyver, S. (2021). A ten-year review of primary school flexible learning environments: Interior design and IEQ performance. *Buildings*, *11*(5), 183. https://doi.org/10.3390/buildings11050183