From Traditional Classrooms to Innovative Learning Environments: Teachers' Perceptions of Space, Furniture, and Environmental Conditions

De las aulas tradicionales a los entornos innovadores de aprendizaje: percepciones del profesorado sobre el espacio, el mobiliario y las condiciones ambientales

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Abstract

This study examines teachers' perceptions of educational spaces, furniture, environmental conditions, and professional competences related to the pedagogical use of space, comparing those working in traditional classrooms with those working in Innovative Learning Environments (ILEs). Framed within the growing international interest that tries to design learning spaces in which learning responds to a student-centred and competency-based learning, the research addresses the persistent lack of empirical guidance on how physical learning environments can effectively support pedagogical innovation. A descriptive and comparative, non-experimental, cross-sectional design was adopted, using an ad hoc online questionnaire validated by experts in educational innovation and learning space design. The final sample comprised 228 teachers from different educational stages in the Valencian Region (Spain). Data were analysed using descriptive statistics and nonparametric tests, specifically the Mann–Whitney U test for ordinal variables and the chi-square test of independence for nominal variables. The results indicate that teachers working in innovative environments report significantly more positive evaluations of spaces, furniture, and environmental conditions, with moderate effect sizes, as well as greater perceived flexibility, adaptability, accessibility and support for collaborative learning. They also report more frequent and diversified use of school spaces and flexible furniture, while traditional contexts remain largely centred on the regular classroom and conventional furnishings. Although no significant differences emerged regarding which spaces, furniture or environmental aspects should be prioritised when initiating change, revealing shared priorities across contexts, teachers in innovative environments consistently reported higher levels of perceived professional competence in planning, managing and pedagogically exploiting educational spaces. Nevertheless a high proportion (as high as 25%) of teachers in innovative environments assert that they lack familiarity with strategies for the distribution and management of group work, or even the planning of such activities in these environments. The findings highlight the strong interdependence between spatial design, material conditions, environmental quality, and teacher competence, suggesting that sustainable educational innovation requires a systemic approach that aligns everyday classroom improvements, investment in flexible furniture and environmental conditions and sustained, practice-oriented professional development.

Keywords: Learning Spaces; School designers; School Furniture; Innovative Learning Environment; Quantitative & qualitative survey.

Resumen

El propósito de este estudio es examinar las percepciones de los docentes respecto a los espacios educativos, el mobiliario, las condiciones ambientales y las competencias profesionales relacionadas con el uso pedagógico del espacio. Para ello, se compararon dos grupos de docentes: aquellos que trabajan en aulas tradicionales y aquellos que trabajan en Entornos de Aprendizaje Innovadores (EAI). En el contexto del creciente interés a nivel internacional en la creación de entornos de aprendizaje centrados en el estudiante y basados en competencias, la investigación aborda la persistente carencia de orientación empírica respecto a la manera en que los espacios físicos de aprendizaje pueden brindar apoyo eficaz a la innovación pedagógica. El enfoque metodológico adoptado fue de tipo descriptivo y comparativo, no experimental y transversal. Para la recopilación de datos, se implementó un cuestionario ad hoc en línea, el cual fue validado por expertos en innovación educativa y diseño de espacios de aprendizaje. La muestra final estuvo compuesta por 228 docentes de diferentes etapas educativas de la Comunidad Valenciana (España). El análisis de los datos se llevó a cabo mediante el empleo de herramientas estadísticas descriptivas y pruebas no paramétricas, específicamente la prueba U de Mann-Whitney para variables ordinales y la prueba chi-cuadrado de independencia para variables nominales. Los resultados obtenidos en el estudio sugieren que los docentes que desempeñan su labor en entornos innovadores muestran una percepción significativamente más positiva hacia los espacios físicos, el mobiliario y las condiciones ambientales, con efectos moderados. Además, estos profesionales perciben una mayor flexibilidad, adaptabilidad, accesibilidad y apoyo al aprendizaje colaborativo. Asimismo, se sostiene la hipótesis de que en los entornos escolares se evidencia un mayor uso y una mayor diversidad en la utilización de los espacios y el mobiliario flexible, mientras que en los entornos tradicionales persiste la utilización predominante del aula convencional y el mobiliario convencional. Si bien no se evidenciaron disparidades significativas en aspectos tales como los espacios físicos, el mobiliario o los elementos ambientales que deben priorizarse al momento de implementar cambios, lo que sugiere la presencia de prioridades comunes en diversos contextos, los docentes de entornos innovadores reportaron consistentemente niveles más elevados de competencia profesional percibida en lo concerniente a la planificación, la gestión y el aprovechamiento pedagógico de los espacios educativos. Sin embargo, una proporción significativa (hasta un 25 %) de los docentes en entornos innovadores admite carecer de conocimiento en estrategias de distribución y gestión de trabajo en grupo, así como en la planificación de actividades en dichos entornos. Los resultados obtenidos evidencian una fuerte interdependencia entre el diseño espacial, las condiciones materiales, la calidad ambiental y la competencia de los profesores. Estos hallazgos sugieren que la innovación educativa sostenible requiere un enfoque sistémico que armonice las mejoras cotidianas en el aula, la inversión en mobiliario flexible y condiciones ambientales, y una formación profesional sostenida y orientada a la práctica.

Palabras clave: Espacios de aprendizaje; Diseño de Escuelas; Mobiliario Escolar: Ambientes de aprendizaje Innovadores; Encuesta Cuantitativa y Cualitativa.

INTRODUCTION

The creation of Innovative Learning Environments has been promoted, since 2012, by different international researchers and institutions (eg. [1-3]). However, teachers often express their doubts about how to design the space and we find it difficult to give an answer based on evidence. This issue is of great practical importance: this situation reveals a gap between the growing institutional discourse on innovative learning environments and teachers' everyday decision-making regarding how educational spaces should be designed and used.

Innovative Learning Environments (ILEs) are defined as highly flexible spaces, equipped with intentional furniture and ubiquitous technology, and used in innovative ways to facilitate student-centred learning experiences [4]. In line with this perspective, international educational institutions have increasingly focused their policies, research, and guidelines on fostering educational systems that support competency-based learning [1,3,5-7], accompanied by practical frameworks and reports aligned with the principles of ILEs [8,9]. Research by Silander, and Ryymin[10] conceptualises educational change as being grounded in three interrelated pillars: pedagogy, architecture, and technology, with pedagogy acting as the primary driver of transformation. From this standpoint, the flexible physical learning environment serves to enable and support diverse pedagogical approaches, rather than dictating them, and address different learner needs [11]. Consequently, educational spaces must be designed with a high degree of adaptability to accommodate a wide range of activities and learning modalities. However, despite the growing emphasis on ILEs, it is noticeable a lack of academic studies providing concrete, evidence-based recommendations regarding the specific design of educational spaces in these contexts. Understanding this gap requires revisiting the historical and conceptual foundations of the traditional classroom model, which continues to shape most school buildings and teaching practices.

THEORETICAL FRAMEWORK
Conceptualisation of the traditional classroom

The Charter for the Construction of Schools [12] establishes the fundamental principles for the construction of new school buildings and emerged as a response to pressing global challenges, including the shortage of educational institutions, widespread illiteracy, and the instability of learning environments. The Charter primarily focuses on the resolution of school facilities for early education and is notable for deliberately avoiding prescriptive dimensional, typological, or construction standards. Instead, it defines four guiding principles for school design: the scale of the building in relation to the child, flexible layouts adapted to age and pedagogical needs, the incorporation of comfort in continuity with domestic and experiential spaces, and the role of architecture and its details as pedagogical material. These principles remain remarkably relevant in contemporary discussions on educational space.

Despite these early pedagogical intentions, as Nair[13] observes, prevailing school architecture has largely evolved from an outdated industrial model, characterised by rigid and linear spatial organisations centred on the teacher and the blackboard. Such configurations tend to constrain participation, limit individual expression, and reinforce passive learning paradigms [14]. This disjunction between pedagogical aspirations and spatial realities is further illustrated by complementary research [15], which identifies three dominant perspectives in school design: schools based on adult experience, reflecting teacher-centred transmission models; schools grounded in children's experiential learning, aligned with active and constructivist pedagogies; and schools conceived from personal perspectives, corresponding to learner-centred approaches that adapt education to individual interests, strengths, and learning pathways. Contemporary empirical work further complicates this picture by showing how new spatial configurations influence teachers' pedagogical decisions and actual use of space: comparative research demonstrates that even when environments are designed to be more flexible, teachers' interpretations and practices mediate how spatial affordances are enacted in practice [16]. Likewise, systematic reviews of smart learning spaces highlight the ongoing shift from traditional, rigid models to dynamic, flexible learning environments that integrate pedagogical, environmental and digital dimensions, underlining both the potential and current limitations in translating design into educational innovation [17].

Within this context, key questions emerge regarding the evolution of public school systems, which over the past decades have prioritised regulatory and quantitative requirements over pedagogical quality and users' needs. Adapting existing school buildings to contemporary educational demands, without major structural changes, requires rethinking interior, transitional, and outdoor spaces and equipping them with flexible furniture. Finally, since pedagogy is enacted through practice, the involvement of teachers through participation and co-design is essential to ensure that educational spaces effectively support innovative learning.

Theoretical Foundations of Educational Change

Pedagogical research, and in particular the incorporation of active methodologies and digital technology, has highlighted the need to redefine the traditional classroom model towards a new concept: that of the 'learning environment'.

According to the Finnish National Board of Education[18], the term 'learning environment' refers to the totality of the physical environment, psychological factors and social relationships in which teaching and learning take place (cited in Silander, and Ryymin[10]). This necessitates a transformation of educational spaces within schools to accommodate these novel understandings of education. Nevertheless, the implementation of such changes within educational institutions is gradual, necessitating a concurrent progression across multiple domains, including pedagogy, learning methodologies, technological infrastructure, physical spaces, and the provision of equipment.

In this regard, numerous international authors have underscored the significance of integrating the design of novel spaces with pedagogical requirements. There is a consensus among researchers that educational spaces function as pedagogical agents, exerting influence on the autonomy, creativity and well-being of students [4,19-21].

Reggio Emilia: space as the 'third teacher'

The concept of space as the 'third teacher' was pioneered by Loris Malaguzzi [22] in the aftermath of the Second World War in the city of Reggio Emilia, thus giving rise to a novel pedagogical proposal [23]. This standpoint accentuates the significance of fostering environments that are open, illuminated, and meticulously designed to stimulate curiosity, autonomy, and peer relationships among students. This perspective reinforces the notion of space as an active pedagogical agent rather than a neutral container for learning.

The Montessori Method: order, autonomy and educational materials

In Montessori pedagogy, space is conceived as a prepared, orderly, and accessible environment that supports autonomy and self-regulation. Understood as a precise "design tool" focused on functionality and order [24], Montessori environments incorporate child-sized furniture, manipulative materials, and freedom of movement, anticipating contemporary discussions on flexibility, autonomy, and the intentional design of learning environments [10].

Herman Hertzberger: architecture for interaction

In architecture, Hertzberger[25] emphasises the educational value of intermediate spaces, such as corridors, stairways, and landings, as settings for informal learning and social interaction. His concept of the school as a "small city" broadens the notion of learning beyond the classroom, framing the school as a social and democratic space in which all areas contribute to educational opportunities.

Mattila: Phenomenon-Based Learning and Flexible Spaces

Mattila[26] contributes to the Finnish framework of phenomenon-based learning by highlighting the need to rethink educational spaces to support interdisciplinary learning. This approach requires flexible and open environments that can be combined for diverse activities. His key contribution is an operational classification of learning environments into four categories based on degrees of public–private use: immediate outdoor spaces, halls and corridors, thematic classrooms, and personal spaces.

In the same line, Nair[13] posits that educational spaces should be conceptualised as flexible and diverse learning ecosystems, capable of adapting to active methodologies and collaboration between students. Together, these contributions emphasise flexibility, diversity of spaces, and pedagogical intentionality as key conditions for innovative learning environments.

Beyond theoretical frameworks, empirical research has provided evidence of the measurable impact of physical learning environments on students' learning and well-being. At the national level, recent research highlights the growing recognition of the role of educational space in learning. For instance, López Gutiérrez[27] adopts a humanistic and aesthetic perspective, arguing that learning environments should go beyond functionality to incorporate beauty, emotional warmth, and symbolic elements that foster well-being, belonging, and deep learning. From a complementary viewpoint, Amann Vargas[28] examines the relationship between architecture and emerging pedagogical demands, particularly in the context of Education for Sustainable Development, emphasising that meaningful educational change requires not only curricular and pedagogical transformation but also architectural redesign that supports autonomy, participation, and critical thinking. Empirical evidence from the HEAD project

further reinforces the impact of physical learning environments, showing that classroom design can account for a significant proportion of variation in students' academic progress, particularly in primary education [29]. Together, these contributions underscore that well-designed educational spaces, combining functional, aesthetic, and environmental qualities, play a crucial role in promoting student well-being, engagement, and improved learning outcomes.

Given that teachers are the primary mediators between space, pedagogy, and everyday classroom practice, their perceptions constitute a key source of evidence for understanding how learning environments function in reality. Addressing the practical need posed, the purpose of this study was to examine teachers' perceptions of space, furniture and environmental conditions, to try to extract specific practical information that could be shared with teachers who are planning to start a physical transformation of the educational spaces.

We contribute to the ILE literature in three ways. First, we share teachers' frequency of use of different spaces and furniture, and the barriers they encounter. Secondly, we collect opinions on what space, furniture or environmental conditions should be prioritized when starting to transform. Thirdly, these aspects are considered conditioned to the place in which teachers develop their teaching, comparing responses to extract tendencies. Together, these contributions aim to bridge the gap between educational theory, spatial design, and teachers' everyday practice.

Main objective
- To analyse and compare teachers' perceptions of educational spaces, furniture, environmental conditions, and professional competences that enable innovative pedagogical practices.

Secondary objectives
- To identify essential elements to foster pedagogical innovation.
- To explore the barriers encountered in the pedagogical use of spaces different to the classroom.
- To examine teachers' perceived knowledge to plan, manage and pedagogically exploit educational space.

METHOD
The study was conducted by an interdisciplinary team of researchers, including staff from the Higher School of Art and Design of Valencia and the University of Valencia. It was carried out, at the explicit request of the competent educational authorities, between January and November 2025, in the Valencian Region (Spain).

It followed a descriptive and comparative research design, grounded primarily in a quantitative methodological approach, with the inclusion of some qualitative elements derived from open-ended responses. The research was non-experimental and cross-sectional, aiming to explore teachers' perceptions and practices related to the use, adequacy, and potential of educational spaces and school furniture to support learning processes.

Data were collected through an online survey specifically designed for this study, which allowed access to a broad and diverse sample of teachers from different educational stages. The study focused on identifying patterns of space usage, perceived barriers, environmental conditions, and experiences of spatial transformation, as well as comparing responses between teachers working in innovative learning spaces and those teaching in traditional classrooms.

Process of development and validation of the instrument
An *ad hoc* questionnaire was developed to gather information on teachers' perceptions of educational spaces and furniture. The design process began with a review of relevant literature and a reflection by the research team on the key dimensions necessary to analyse the relationship between physical learning environments and pedagogical practices. The resulting instrument consisted of 21 questions, combining closed-ended items with Likert-type scales and several open-ended questions to capture qualitative insights.

The questionnaire addressed multiple dimensions, including: frequency and type of use of different school spaces, characteristics and adequacy of furniture, environmental conditions (e.g., lighting, temperature, acoustics), perceived barriers to using alternative spaces, sources of funding for spatial changes, and experiences of innovation or transformation within schools.

Prior to dissemination, the instrument was reviewed and validated by 7 experts in educational innovation and learning space design. Each expert was selected based on their knowledge and experience in the field. All of them

have specific training in the topics of Future Classroom Lab or Innovative Learning Environments. Among them, there are five PhD holders and one individual with a master's degree. They were asked to evaluate two aspects for each item, following Lawshe's guidelines[30] with modifications by Tristán-López[31]: the clarity of the wording (Likert-type scaling technique with four response categories ranging from 4 to 1, where: 4 = Very high and 1 = Very low) and its importance, defined as the degree of significance the item had within its dimension (1) Essential, 2) Useful but not essential, and 3) Not important). Experts could share any concern or comment in an open-ended section for each question. This expert validation process ensured the clarity, relevance, and coherence of the items with the objectives of the study. Feedback from the experts led to refinements in wording and structure in 17 questions, enhancing the overall validity of the questionnaire. The final version was implemented using a digital data collection platform, enabling efficient and anonymous participation.

Sample

The final sample consisted of 228 teachers from different educational stages, including Early Childhood Education, Primary Education, Secondary Education, and Vocational Training. The majority of participants worked in publicly funded schools. Participation was voluntary, and a non-probabilistic snowball sampling technique was employed: after an initial convenience-based selection, participants were encouraged to share the survey within their professional networks.

A key criterion for analysis was whether teachers reported working in innovative learning spaces, such as Future Classroom Labs, transformative classrooms, or similar environments characterised by flexible and innovative furniture, or exclusively in traditional classrooms. This distinction enabled comparative analyses between both groups.

All responses were collected anonymously, and data collection took place between May and July 2025. Given the voluntary and non-random nature of the sample, the results cannot be generalised to the entire teaching population; however, they provide robust and meaningful indicators of current trends and perceptions regarding educational spaces and furniture.

Table 1: Distribution of background characteristics of respondents (N=46)

	Frequency (n)	Percent (%)
Type of school		
Public	225	98.7
Private publicly funded	2	0.9
Private	1	0.4
Stage		
Infant Education	52	22.8
Primary Education	106	46.5
Secondary Education	33	14.5
Vocational Training	27	11.8
Others	10	4.4
Gender		
Female	180	78.9
Male	42	18.4
I prefer not to share it	6	2.6
Working in an ILE		
Yes	48	21.1
No	172	75.4
I'm not sure/I don't know	8	3.5

Data analysis

Data analysis was conducted using the statistical package IBM SPSS 28, using descriptive and comparative statistical procedures. Quantitative data were analysed to obtain frequencies, percentages, and measures of central tendency, allowing for an overall description of teachers' perceptions and practices. Two nonparametric statistical tests were used to analyze the results, selected according to the level of measurement of the variables and the characteristics of the data. The Mann–Whitney U test was applied to compare differences between teachers working in traditional and innovative environments when the dependent variables were ordinal or continuous but did not meet the assumption of normality, allowing for robust group comparisons. The chi-square test of independence was used to analyze associations between categorical (nominal) variables, as it is appropriate for examining differences in frequency distributions between independent groups. The use of nonparametric tests ensured methodological rigor and statistical validity given the nature of the data collected.

RESULTS

General information

In this first section, general information was gathered, concerning (1) use of spaces (Figure 1) and general state of them (Figures 2 and 3), and (2) reasons motivating the change (if there was any) and funding.
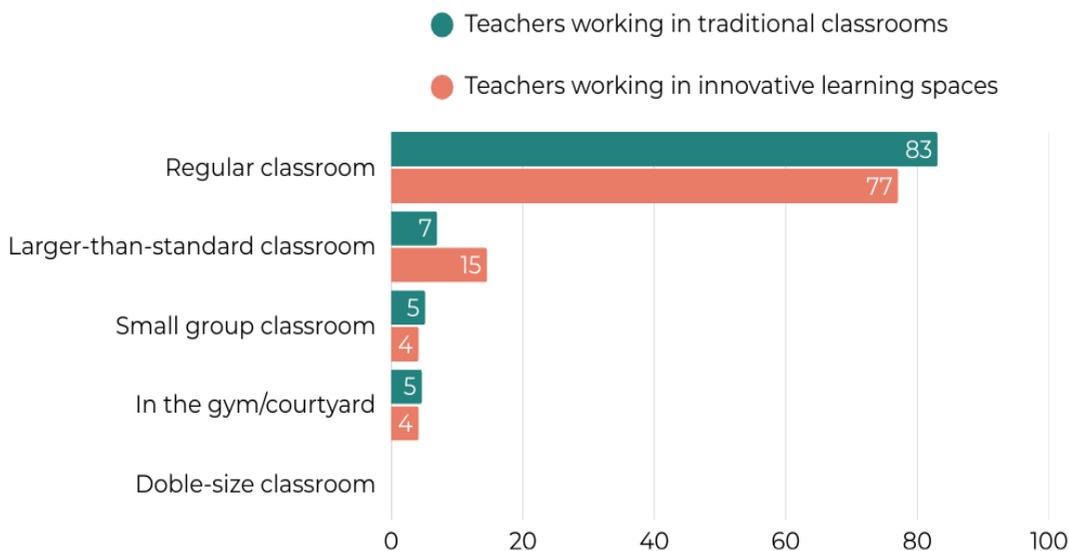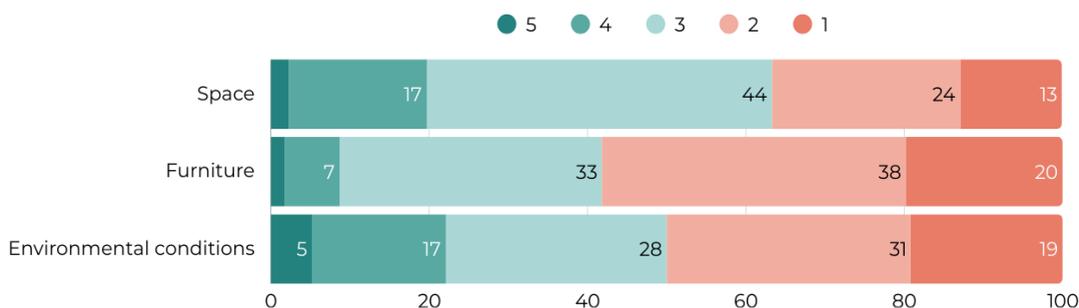

Figure 1: Descriptive analysis (percentages) of question 1: In which space do you normally teach? Source: created by the authors from the data obtained.
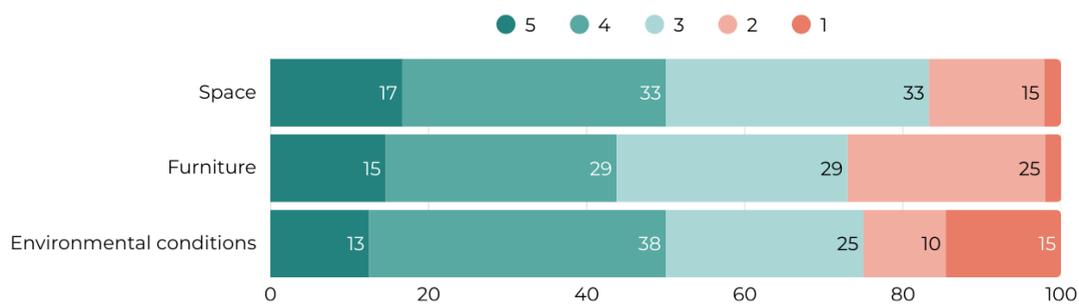

Figure 2: Descriptive analysis (percentages) of question 2 according to type of respondents: On a scale from 1 to 5 (where 1 represents the lowest rating and 5 the highest), how would you assess the overall quality of the spaces, furniture, and environmental conditions of your school in terms of their capacity to foster learning? Source: created by the authors from the data obtained.

The Mann–Whitney U test revealed statistically significant differences across all three dimensions, consistently favoring teachers working in innovative environments. Specifically, significant differences were found in the evaluation of spaces (Z=−4.30, p<.001, r≈.29), furniture (Z=−5.27, p<.001, r≈.36), and environmental conditions (Z=−3.38, p<.001, r≈.23). The moderate effect sizes indicate that these differences are practically meaningful, with teachers in innovative environments reporting a more positive overall evaluation of the physical learning environment.

Opinions of teachers were gathered related to the flexibility and adaptability of the space in which they teach, to use different activities and methodologies, and if it facilitates collaborative learning and interaction among students (Figure 3).
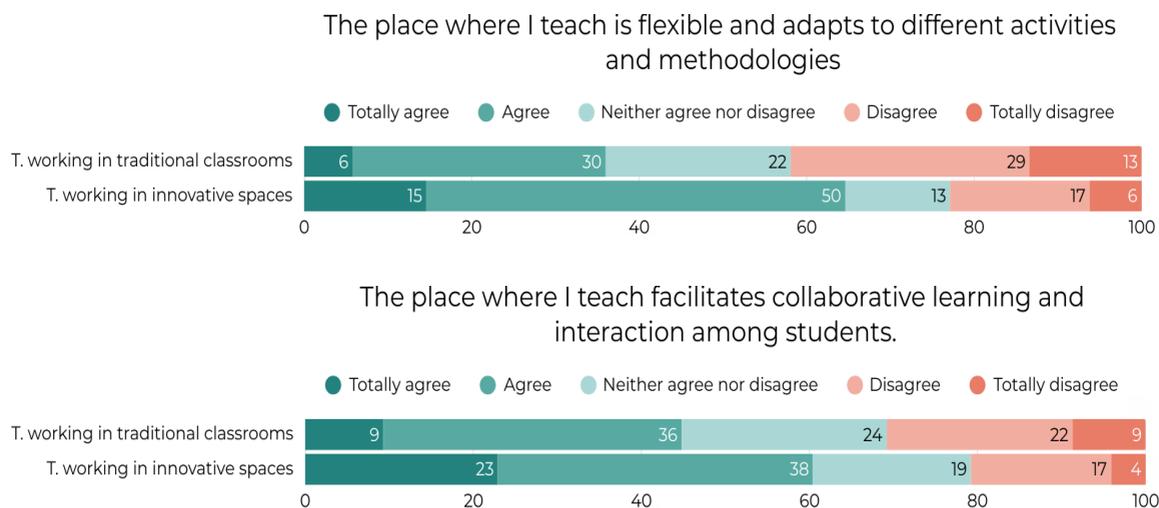

Figure 3: Descriptive analysis (percentages) of question 3 according to type of respondents: How much do you agree with the following statements? Source: created by the authors from the data obtained.

The Mann–Whitney U test revealed statistically significant differences for both items: teachers working in innovative environments assigned significantly higher ratings to the statement that space facilitates collaborative learning and interaction among students (Z=−2.36, p=.018, r≈.16), and even clearer differences were found in the perception that space is flexible and adapts to different activities and methodologies (Z=−3.36, p<.001, r≈.23), indicating a more positive perception of the pedagogical potential of the space they currently use.
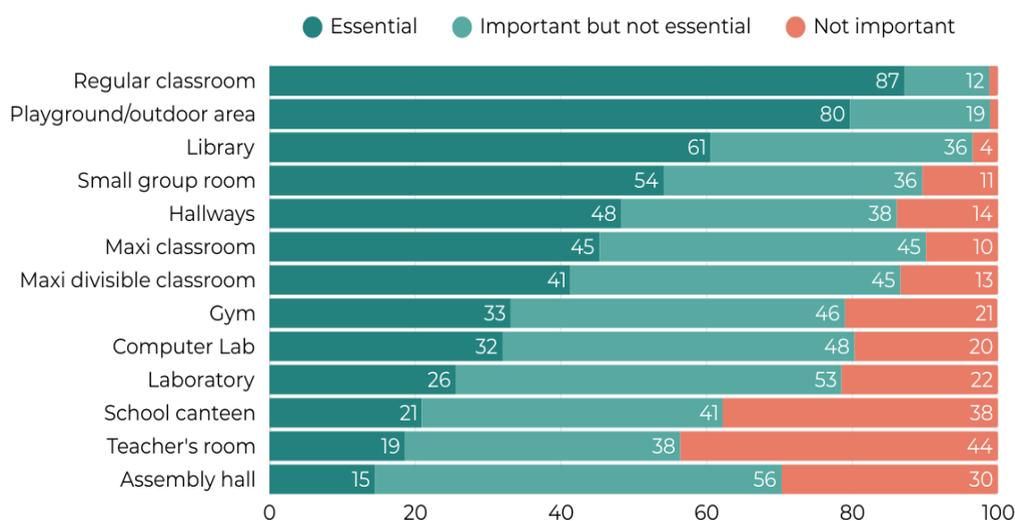
Regarding motivations for change, 72% of teachers reported having implemented spatial modifications as a result of changes in their teaching methodology, whereas only 2% indicated aesthetic reasons. In contrast, 21% of respondents stated that they had not undertaken any spatial changes.

With respect to funding, respondents reported a variety of sources. Specifically, 43% indicated that changes were financed through regional Innovation and Educational Research Projects promoted by the educational authorities. Other sources included parents' associations (12%), municipal funding (9%), specific administrative programmes aimed at improving school buildings (6%), and Erasmus projects (6%). Additionally, 6% of participants reported being unaware of the origin of the funding. Notably, 36% of teachers stated that they had not received any external funding to support changes.

Analysis of the teaching space

At this stage, four questions were posed. Firstly, teachers were asked to indicate the grade of importance that a list of school spaces had when developing innovative pedagogical practices. Figure 4 shows first the answers given by teachers who work in traditional settings and secondly the ones given by those teachers who work in innovative spaces.

Teachers working in traditional classrooms

Legend: ● Essential ● Important but not essential ● Not important

Space	Essential	Important but not essential	Not important
Regular classroom	87	12	
Playground/outdoor area	80	19	
Library	61	36	4
Small group room	54	36	11
Hallways	48	38	14
Maxi classroom	45	45	10
Maxi divisible classroom	41	45	13
Gym	33	46	21
Computer Lab	32	48	20
Laboratory	26	53	22
School canteen	21	41	38
Teacher's room	19	38	44
Assembly hall	15	56	30

Teachers working in innovative learning spaces

Legend: ● Essential ● Important but not essential ● Not important

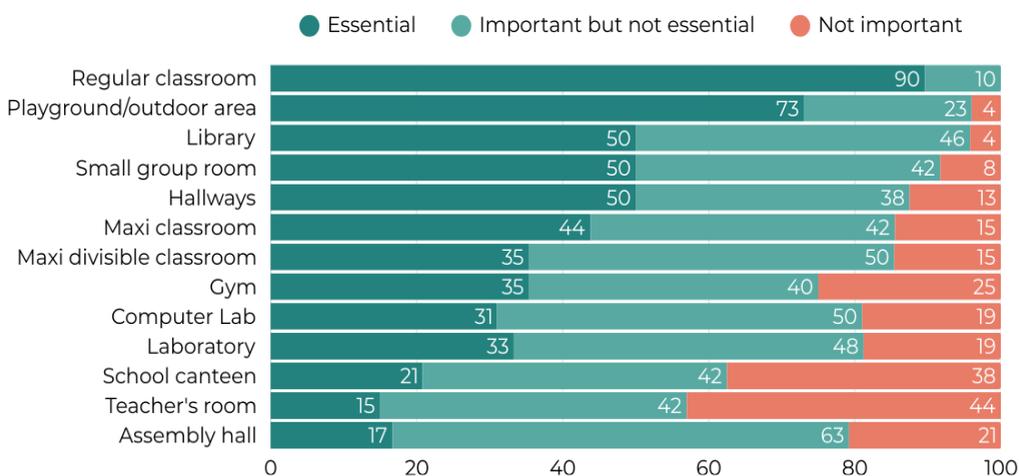| Space	Essential	Important but not essential	Not important
Regular classroom	90	10	
Playground/outdoor area	73	23	4
Library	50	46	4
Small group room	50	42	8
Hallways	50	38	13
Maxi classroom	44	42	15
Maxi divisible classroom	35	50	15
Gym	35	40	25
Computer Lab	31	50	19
Laboratory	33	48	19
School canteen	21	42	38
Teacher's room	15	42	44
Assembly hall	17	63	21

Figure 4: Descriptive analysis (percentages) of question 4 according to type of respondents: What spaces do you consider essential for the development of innovative pedagogical practices? Source: created by the authors from the data obtained.

In both groups, the regular classroom and the playground or outdoor area are overwhelmingly considered essential, underscoring a common recognition of the centrality of the classroom and the growing pedagogical value attributed to outdoor learning. Teachers working in innovative learning spaces display a slightly higher value to other learning environments, such as libraries, small group rooms, hallways and maxi classrooms. Both groups converge in assigning lower levels of essentiality to spaces such as the school canteen, teachers' room, and assembly hall. The Mann–Whitney U test was applied, and the results indicate that there are no statistically significant differences between the two groups for any of the spaces analyzed ($p>.05$ in all cases). The mean ranks are very similar for teachers working in traditional and innovative environments, suggesting a shared perception of the importance of educational space regardless of the type of pedagogical environment.

Secondly, teachers were questioned about the frequency in which they use the different spaces of the building to work with their students. Figure 5 gathers the answers according to the type of setting they expressed they work in.
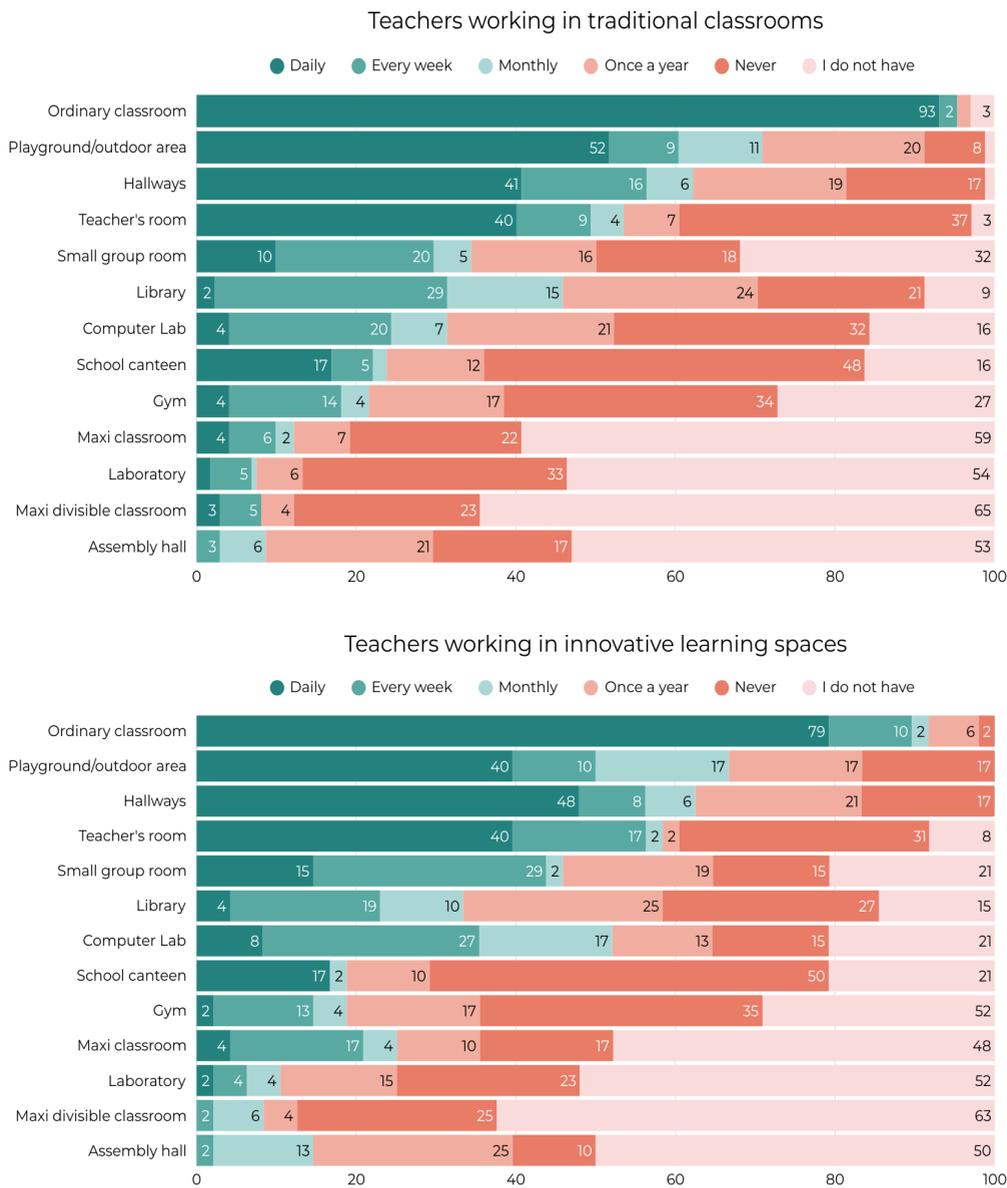
Teachers working in traditional classrooms

Daily ● Every week ● Monthly ● Once a year ● Never ● I do not have

Space	Values
Ordinary classroom	93, 2, 3
Playground/outdoor area	52, 9, 11, 20, 8
Hallways	41, 16, 6, 19, 17
Teacher's room	40, 9, 4, 7, 37, 3
Small group room	10, 20, 5, 16, 18, 32
Library	2, 29, 15, 24, 21, 9
Computer Lab	4, 20, 7, 21, 32, 16
School canteen	17, 5, 12, 48, 16
Gym	4, 14, 4, 17, 34, 27
Maxi classroom	4, 6, 2, 7, 22, 59
Laboratory	5, 6, 33, 54
Maxi divisible classroom	3, 5, 4, 23, 65
Assembly hall	3, 6, 21, 17, 53

Teachers working in innovative learning spaces

Daily ● Every week ● Monthly ● Once a year ● Never ● I do not have

Space	Values
Ordinary classroom	79, 10, 2, 6, 2
Playground/outdoor area	40, 10, 17, 17, 17
Hallways	48, 8, 6, 21, 17
Teacher's room	40, 17, 2, 2, 31, 8
Small group room	15, 29, 2, 19, 15, 21
Library	4, 19, 10, 25, 27, 15
Computer Lab	8, 27, 17, 13, 15, 21
School canteen	17, 2, 10, 50, 21
Gym	2, 13, 4, 17, 35, 52
Maxi classroom	4, 17, 4, 10, 17, 48
Laboratory	2, 4, 4, 15, 23, 52
Maxi divisible classroom	2, 6, 4, 25, 63
Assembly hall	2, 13, 25, 10, 50

Figure 5: Descriptive analysis (percentages) of question 5 according to type of respondents: How often do you use the following spaces to work with your students? Source: created by the authors from the data obtained.

The Mann–Whitney U test was applied and the results revealed statistically significant differences in the use of some spaces: the traditional classroom was used more frequently by teachers in traditional environments ($Z=-3.77$, $p<.001$), with a small-to-medium effect size ($r=.26$), whereas teachers in innovative environments reported significantly greater use of the computer classroom ($Z=-2.80$, $p=.005$), also with a small-to-medium effect size ($r=.21$). No statistically significant differences were found in the use of the other spaces ($p>.05$ in all cases), although descriptive trends favoring innovative environments were observed for some of these spaces: teachers working in innovative learning spaces, however, report a more diversified use of alternative spaces, particularly the playground or outdoor areas, hallways and small group rooms, which are used more frequently on a weekly or occasional basis than in traditional settings. Teachers in traditional classrooms show higher proportions of infrequent use or non-use of spaces such as libraries, computer labs, maxi classrooms and laboratories, often combined with higher percentages indicating that these spaces are not available in their centres. While both groups make limited use of spaces such as the school canteen, gym and assembly hall for instructional purposes, this tendency is more pronounced in traditional classrooms.

Thirdly a list of possible barriers they could encounter when using spaces other than their classroom was presented, asking teachers to choose as many options as they considered. Figure 6 shows the percentage of teachers who selected each barrier.
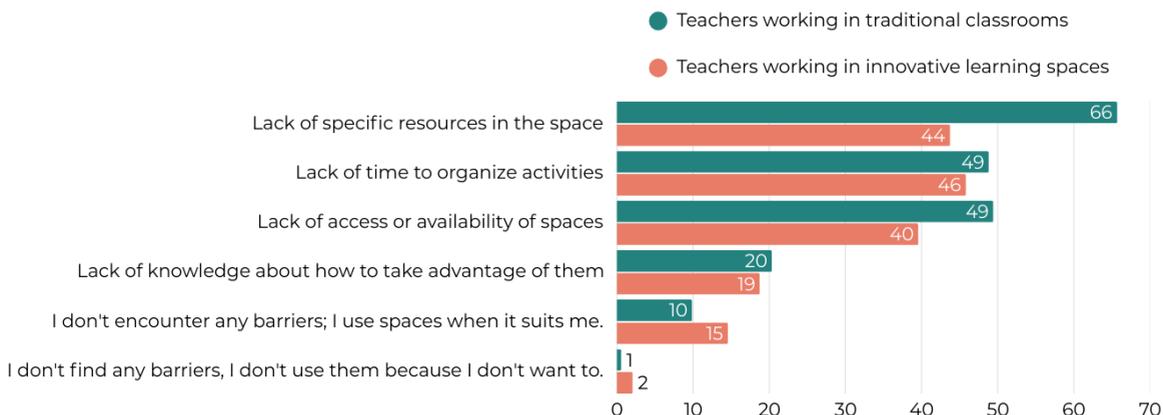

Figure 6: Descriptive analysis (percentages) of question 6 according to type of respondents: What barriers do you encounter when using spaces other than the regular classroom? Source: created by the authors from the data obtained.

Structural and organisational constraints emerge as the most significant obstacles for both groups, particularly the lack of specific resources in the space, lack of time to organise activities and limited access or availability of alternative spaces. These barriers are consistently reported more frequently by teachers working in traditional classrooms, with the lack of specific resources standing out as especially pronounced. Teachers in innovative learning spaces report these barriers to a lesser extent. Lack of knowledge about how to take advantage of alternative spaces is reported at similar levels in both groups. Only a small proportion of respondents in either group report encountering no barriers, although this perception is slightly more common among teachers working in innovative learning spaces.

Finally, the last question related to the space asked teachers to select only one space which would be the first one they would advise anyone to change. The answers to this question are presented in figure 7.
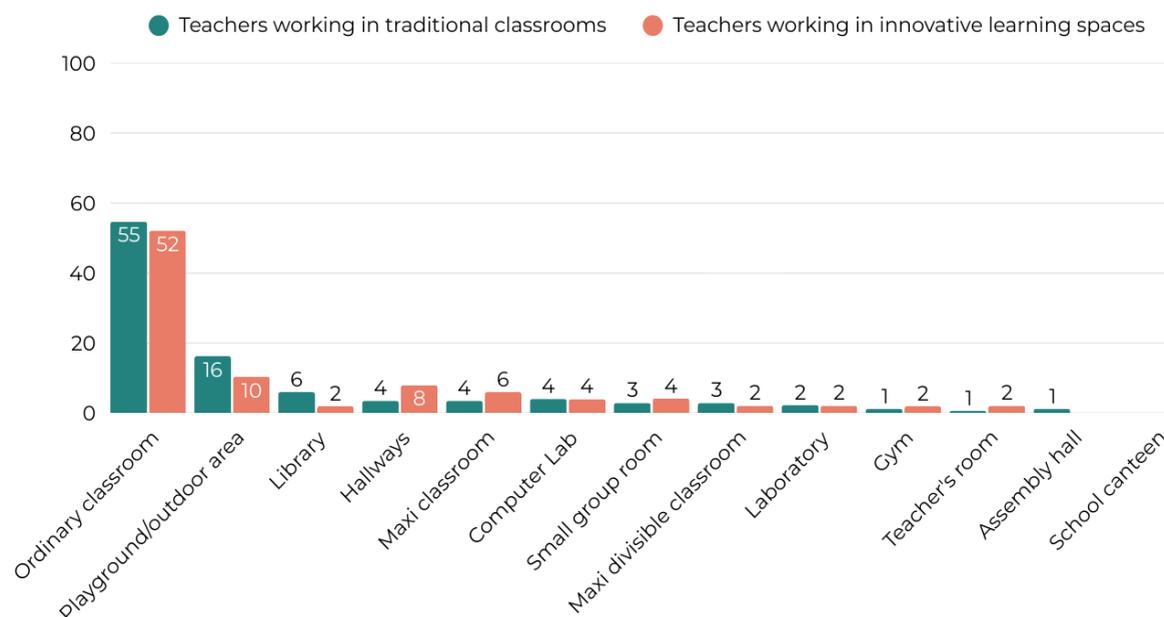

Figure 7: Descriptive analysis (percentages) of question 7 according to type of respondents: If a center wants to start modifying its spaces, which space would you recommend they focus on first? Source: created by the authors from the data obtained.

The association between the type of pedagogical environment (traditional vs. innovative) and the space that teachers recommend prioritizing to initiate changes in a school was examined using the chi-square test of independence. The results indicate that there is no statistically significant association between the two variables (χ^2 (12) =10.37, p=.583), suggesting that the choice of the priority space is similar in both groups. The effect size, measured using Cramer's V, was low (V=.22), reinforcing the absence of a practically meaningful relationship. At a descriptive level, the ordinary classroom is identified as the primary space to focus on, with slightly higher percentages among teachers in traditional classrooms. Similar consideration received the playground or outdoor area. Secondarily, teachers working in innovative learning spaces are relatively more inclined to prioritise hallways, maxi classrooms, and other flexible or shared spaces.

Analysis of the furniture

Following the previous structure, three questions were formulated. Firstly, the suitability of different pieces of furniture to facilitate the creation of learning moments was explored. The responses to this question are displayed in Figure 8.
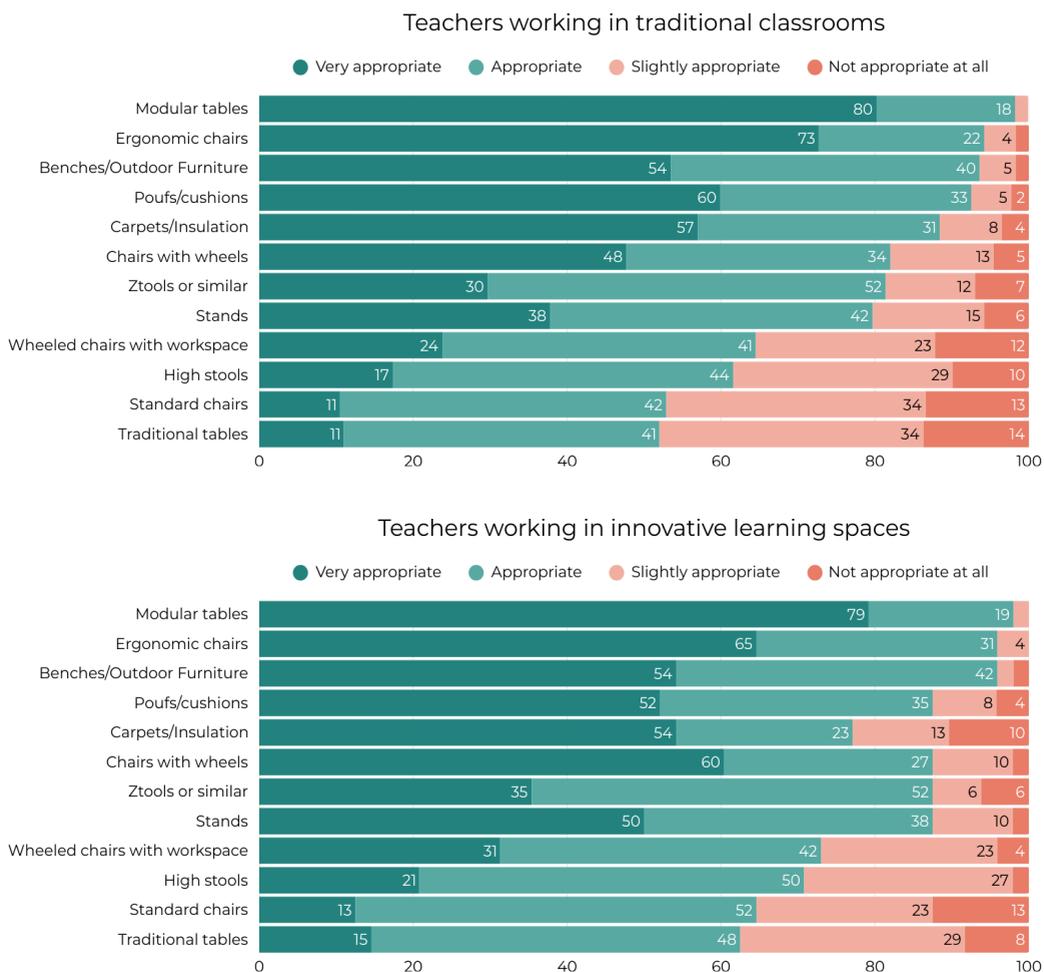

Figure 8: Descriptive analysis (percentages) of question 8 according to type of respondents: How suitable do you consider this furniture to be in the educational center to facilitate the creation of work and learning moments? Source: created by the authors from the data obtained.

In both groups, modular tables and ergonomic chairs receive the highest levels of positive evaluation. However, teachers working in innovative learning spaces tend to report slightly higher proportions of "very appropriate" responses for furniture associated with flexibility and mobility, such as chairs with wheels, stands, and zTools or similar. Conversely, teachers in traditional classrooms display comparatively higher levels of neutral or negative

assessments for these same items. Regarding poufs and cushions, this type of furniture receives a mostly positive rating, indicating that teachers recognize its pedagogical potential. Both groups converge in their relatively low valuation of standard chairs, traditional tables and high stools, which accumulate the highest percentages of "slightly appropriate" and "not appropriate at all" responses. No statistically significant differences were found when applying the Mann–Whitney U test (p>.05 in all cases).

Secondly, the frequency of use of the furniture studied was explored (Figure 9).
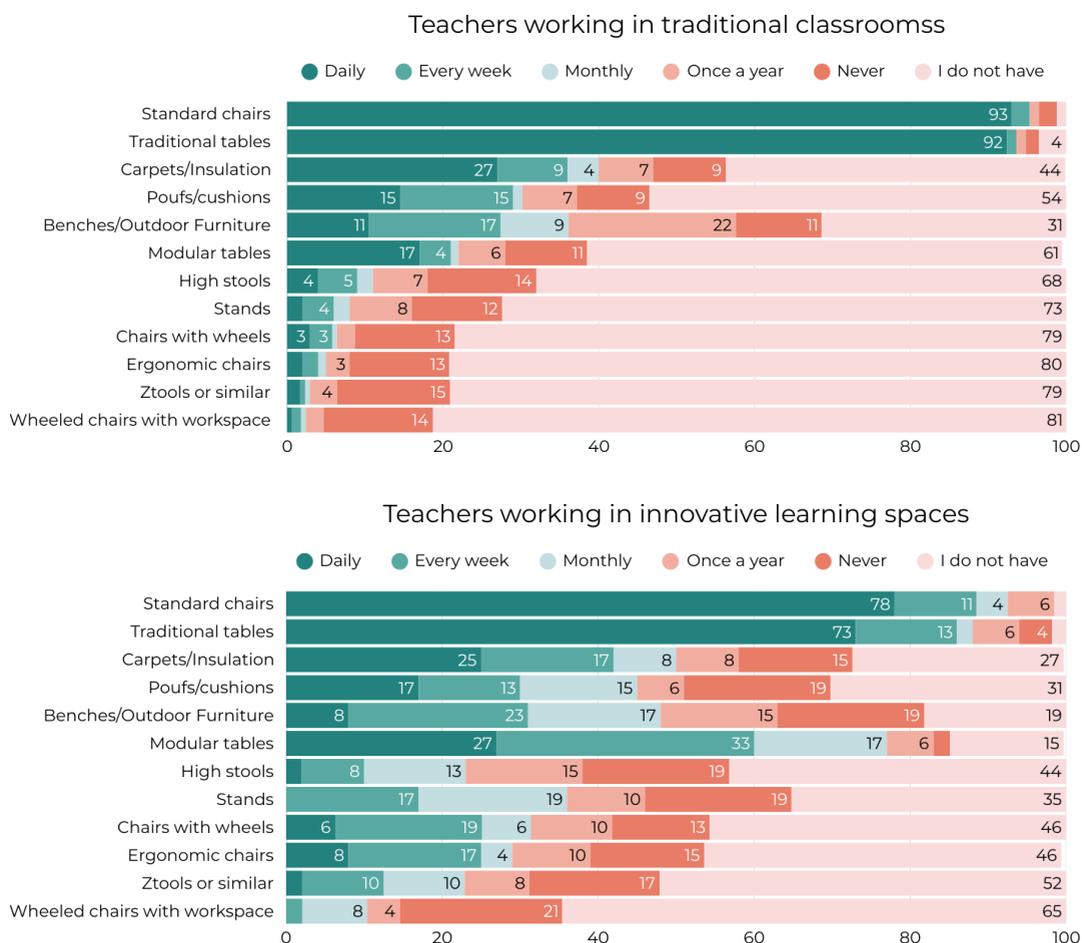
Figure 9: Descriptive analysis (percentages) of question 9 according to type of respondents: Do you use this furniture in your educational activities? Source: created by the authors from the data obtained.

In both contexts, standard chairs and traditional tables are the most frequently used items, particularly in traditional classrooms, where daily use exceeds 90%, underscoring the continued dominance of conventional furniture. However, teachers working in innovative learning spaces report a more diversified pattern of use, with higher frequencies of weekly and monthly use of modular tables, carpets or insulation, poufs/cushions, and benches or outdoor furniture. The Mann–Whitney U test was applied, as the assumption of normality was not met. The results revealed statistically significant differences for several types of furniture. Specifically, teachers in traditional environments reported more frequent use of traditional tables (Z=−4.43, p<.001, r≈.30) and standard chairs (Z=−3.13, p=.002, r≈.21), whereas teachers in innovative environments reported significantly higher use of ergonomic chairs (Z=−2.70, p=.007, r≈.35), chairs with wheels (Z=−2.26, p=.024, r≈.28), and ZTools-type or similar chairs (Z=−2.62, p=.009, r≈.34). No statistically significant differences were found in the use of modular tables, chairs with wheels and workspace, high stools, poufs or cushions, stands, benches or outdoor furniture, or floor mats and insulating materials (p>.05 in all cases). A key distinction between the two groups concerns the availability of innovative furniture. In traditional classrooms, a large proportion of respondents report not having access to items such as wheeled chairs with workspace, chairs with wheels, ergonomic chairs, stands, and Ztools

or similar, with percentages frequently exceeding 70%. By contrast, although these items are still not universally available in innovative spaces, their reported availability and occasional use are notably higher. Nevertheless, even within innovative learning spaces, several types of flexible or mobile furniture are used only sporadically or are absent for a substantial proportion of teachers.

Finally, once again, teachers were invited to choose the piece of furniture they would advise to change first. To answer this question, a list was provided and each teacher could only choose one option from that list. Figure 10 compiles in green the data obtained from those teachers who teach in a traditional setting and in orange the ones from an innovative setting.
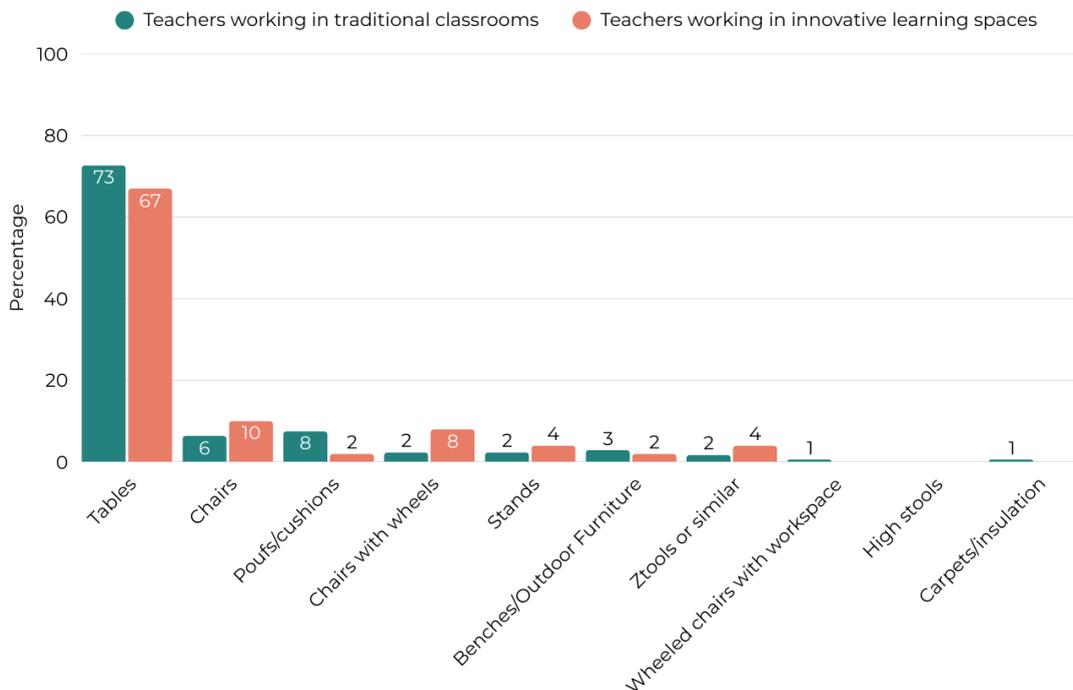

Figure 10: Descriptive analysis (percentages) of question 10 according to type of respondents: If a school/high school wants to start modifying its furniture, what would be the first element you would recommend they focus on? Source: created by the authors from the data obtained.

A clear majority of respondents selected tables as the primary focus, with this preference being slightly more pronounced among teachers working in traditional classrooms (73%) than among those working in innovative learning spaces (67%). Beyond this shared priority, notable differences emerge in secondary choices. Teachers working in innovative learning spaces assign greater importance to chairs (10% compared to 6%), chairs with wheels (8% compared to 2%), and stands (4% compared to 2%), reflecting a stronger orientation towards mobility, adaptability, and dynamic classroom configurations. In contrast, teachers in traditional classrooms place relatively more emphasis on poufs and cushions (8% compared to 2%) and, to a lesser extent, benches or outdoor furniture. These responses were analyzed using the chi-square test of independence, which indicated that there is no statistically significant association between the two variables ($\chi^2(11)=9.55$, p=.571), with a small effect size (V=.21), suggesting that the declared priorities are similar in both groups.

Analysis of the environmental conditions

In this section, two questions were formulated to examine teachers' perceptions of the environmental conditions of their teaching spaces and to identify the aspect they would prioritise when planning improvements. Figure 11 reflects the answers to the first question given by teachers from traditional settings differentiated from the ones given by staff who teach in innovative classrooms.

Teachers in innovative spaces report higher proportions of positive evaluations ("very good" and "good") across nearly all dimensions, particularly in connectivity, physical accessibility, flexibility of layout and access to nature. In

contrast, teachers in traditional classrooms consistently report higher percentages of negative evaluations ("bad" and "very bad"), most notably regarding flexibility, acoustics, access to nature and temperature. Temperature emerges as a critical issue in both contexts. While lighting and air quality are relatively well valued in both settings, innovative spaces still display higher positive responses.

The Mann–Whitney U test was applied, revealing statistically significant differences across several dimensions. Teachers working in innovative environments assigned significantly higher ratings to space for students (Z=−2.14, p=.032, r≈.14), physical accessibility and ease of movement (Z=−2.23, p=.026, r≈.15), spatial flexibility to modify and adapt layouts (Z=−3.12, p=.002, r≈.21), and, most notably, connectivity (Z=−3.72, p<.001, r≈.25). These effect sizes range from small to moderate, with stronger effects observed for spatial flexibility and connectivity. No statistically significant differences were found for other environmental variables such as acoustics, lighting, air quality, temperature, color, or access to nature (p>.05), although mean ranks were consistently higher for teachers in innovative environments across most of these dimensions.
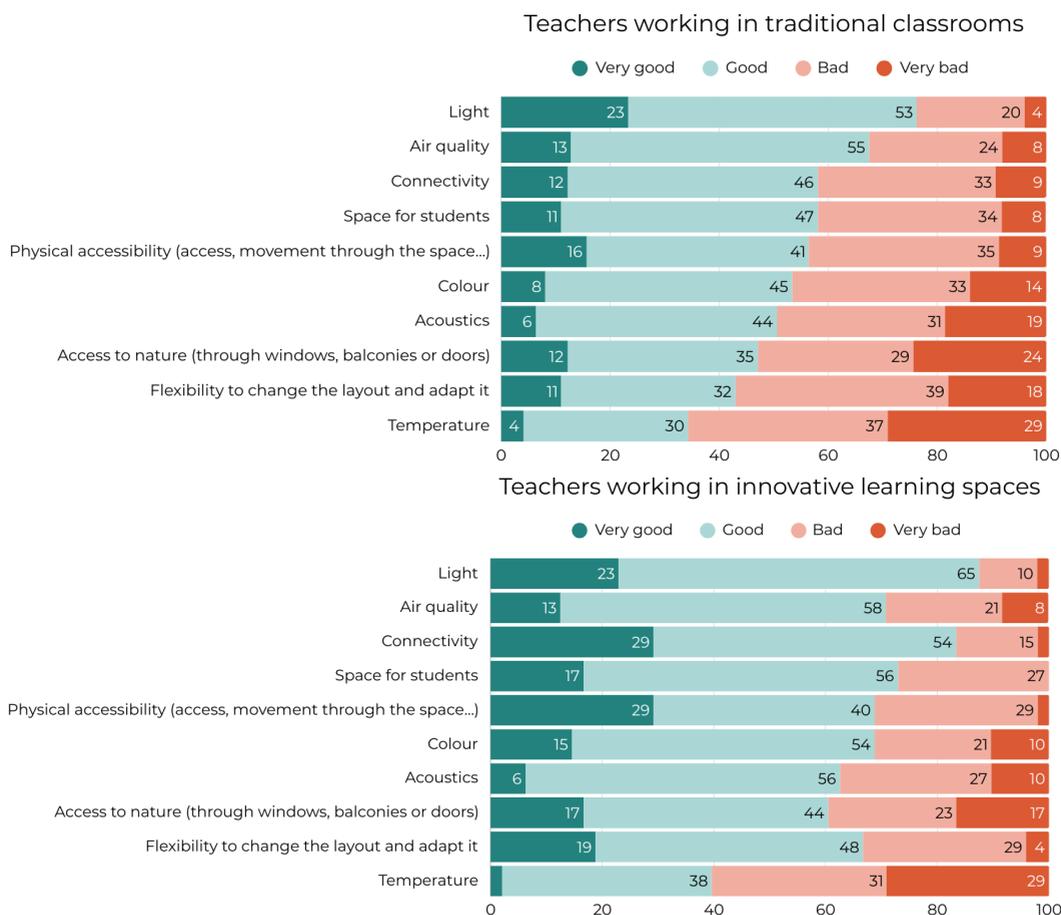

Figure 11: Descriptive analysis (percentages) of answers to question 11 according to type of respondents: Focusing on the area where you teach the most classes, how would you describe the following elements? Source: created by the authors from the data obtained.

Figure 12 compiles the answers of teachers related to the first element they would change in the environment.

The responses were analyzed using the chi-square test of independence, leading to the conclusion that there is no statistically significant association between the two variables ($\chi^2(10)=15.13$, p=.128), with a low-to-moderate effect size (V=.26). At a descriptive level, in both groups, space for students clearly emerges as the primary priority when initiating improvements to classrooms or learning environments, although this preference is more pronounced among teachers in traditional classrooms (71%) than among those in innovative spaces (58%). In contrast, teachers working in innovative learning spaces place relatively greater emphasis on temperature (17% compared to 12%) and

light (10% compared to 4%). Other elements, such as access to nature, receive similar and comparatively lower levels of prioritisation in both groups, while acoustics, colour, and air quality are mentioned only marginally.
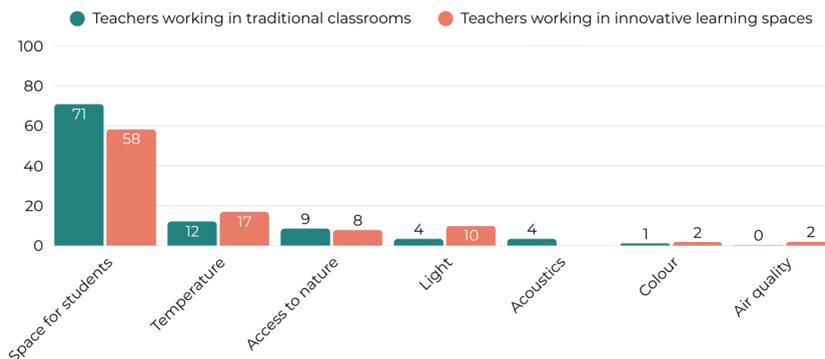

Figure 12: Descriptive analysis (percentages) of answers to question 12 according to type of respondents: If a school or teacher wants to start modifying classrooms or spaces, what would be the first element you would recommend they focus on? (Try not to think about the specific problems of your school, but rather in general terms.) Source: created by the authors from the data obtained.

Analysis of the teachers' knowledge to use the educational space

According to the secondary objective exposed, the teachers' perception of their own knowledge of strategies to use the educational space was explored. They had to express their grade of agreement to five different elements (Figure 13).

Figure 13: Descriptive analysis (percentages) of question 13 according to type of respondents: How much do you agree with the following statements? Source: created by the authors from the data obtained.

The results of the Mann-Whitney U test show that teachers in innovative environments reported significantly higher levels of self-efficacy across most of the dimensions analyzed. Specifically, statistically significant differences were found in knowledge of strategies for distributing space at different moments to better support learning (Z=−2.90, p=.004, r≈.20), in knowledge of group management strategies for working in less traditional spaces (Z=−2.75, p=.006, r≈.19), in the ability to plan the use of different spaces within the classroom (Z=−2.96, p=.003, r≈.20), and to plan the use of spaces outside the classroom (Z=−2.63, p=.009, r≈.18). In all cases, effect sizes ranged from small to approaching moderate, indicating consistent and pedagogically meaningful differences. For the item referring to knowing how space should be designed (lighting, color, acoustics) to enhance learning, a trend toward statistical significance was observed (Z=−1.76, p=.078, r≈.12), also with higher mean ranks among teachers in innovative environments.

DISCUSSION
Analysis of the teaching space
It seems that there is a convergence in considering regular classrooms and the playgrounds as essential spaces to develop innovative pedagogical practices, closely followed by the library, small group rooms and hallways. This may show a shared attribute of pedagogical relevance to transitional and flexible spaces.

Focusing on the second question (frequency of use of different educational spaces), the findings indicate that innovative learning spaces are associated with more frequent and varied use of different areas within the school, whereas teaching in traditional classrooms remains largely confined to the ordinary classroom. To study if this was related to organisational, spatial and cultural constraints that limit the pedagogical exploitation of the broader school environment, the third question analyzed the barriers teachers encounter when using spaces other than the regular classroom. The persistence of high percentages for each barrier analyzed indicates that even innovative contexts are not free from structural limitations. Results suggest that improved spatial design, resource provision or organisational support may partially mitigate the shared constraints. Moreover, lack of knowledge about how to take advantage of alternative spaces is reported at similar levels in both groups, pointing to a cross-cutting need for targeted professional development. These findings underscore that expanding the pedagogical use of school spaces requires not only innovative designs, but also coordinated organisational planning, adequate resourcing and sustained teacher support, coherently with French, *et al.*[2].

The shared preference of prioritising the classroom when implementing changes underscores the central role of it as the core setting of pedagogical activity and highlights its perceived potential as a lever for broader educational change. Secondly, the greater emphasis of both groups on the playground suggest a growing recognition of its educational value as an accessible alternative to the classroom. The slight trend of teachers working in innovative spaces to prioritise other flexible or shared educational spaces may reflect a more distributed and expansive conception of the learning environment.

The findings have several important implications. At the school level, the convergence in identifying the regular classroom and playgrounds as essential spaces for innovative pedagogical practices suggests that innovation strategies should prioritise everyday, highly accessible environments rather than relying exclusively on specialised or exceptional spaces. Coherently, incremental improvements to all classrooms may have a broader and more equitable impact than isolated flagship projects (such as creating one Future Classroom Lab or similar). This highlights the need for whole-school approaches that reconceptualise transitional and flexible spaces, such as libraries, small group rooms and hallways, as integral components of the learning ecosystem, supported by clear organisational frameworks that facilitate their regular pedagogical use. Furthermore, the similar levels of reported lack of knowledge regarding the pedagogical use of alternative spaces across both groups underscore the importance of sustained, targeted professional development. Teacher training policies should therefore explicitly address the pedagogical affordances of different spaces, focusing on practical strategies for planning, managing and integrating diverse environments into daily teaching practice.

Analysis of the furniture
Firstly, there is a shared recognition of the central role of modular tables and ergonomic chairs in supporting flexible and student-centred pedagogical practices. The higher proportion of positive responses among teachers working in innovative learning spaces to furniture associated with flexibility and mobility suggest greater familiarity with or effective integration of these elements in daily practice. The higher levels of neutral or negative assessments of teachers in traditional classrooms for these same items may reflect limited availability, reduced use, or contextual constraints that hinder their pedagogical potential. The convergence of both groups in valuing lower the standard

chairs, traditional tables and high stools may reflect their perceived misalignment with contemporary pedagogical approaches.

Secondly, the findings related to the second question, indicate that while innovative learning spaces facilitate a broader and more frequent use of diverse furniture types, traditional classrooms remain largely constrained by limited access to non-conventional furniture. These results reinforce the idea that pedagogical innovation is closely linked not only to teachers' intentions or training, but also to the material conditions and infrastructural investment that enable, or restrict, the practical use of flexible learning environments.

Finally, answers to the third question are coherent with the ones of the first. Convergence in considering tables as the primary focus when changing furniture highlights their central role in structuring classroom activities and enabling pedagogical flexibility. Moreover, teachers in innovative learning spaces prioritise elements that support movement and reconfiguration, basic elements of pedagogical innovation [32].

These findings entail several relevant implications. The shared recognition of the importance of modular tables and ergonomic chairs underscores the need to prioritise these elements in furniture procurement policies, as they seem to constitute a foundational infrastructure for flexible and student-centred pedagogical practices. Policies aimed at educational innovation should adopt a systemic approach that aligns professional development, spatial design and furniture provision, rather than addressing these dimensions in isolation. Incremental, well-targeted interventions, starting with highly impactful elements such as tables and chairs and extending towards mobile and reconfigurable furniture, may represent an effective and scalable strategy for supporting pedagogical change across diverse educational contexts, in coherence with Patrix, and Benade[33] studies.

Analysis of the environmental conditions

Taken together, findings indicate that innovative learning spaces tend to offer more supportive environmental conditions for teaching and learning, whereas traditional classrooms continue to present structural and environmental limitations that may hinder pedagogical innovation and student well-being.

Results concerning the primary priority when initiating improvements to classrooms or learning environments suggest that spatial constraints, specially space for students, remain a critical concern, particularly in more conventional settings. Being temperature and light the second and third aspect chosen indicate a heightened awareness of environmental comfort factors once basic spatial needs have been partially addressed. Several studies would support these considerations [34,35], some of them evidencing, for example, that a moderate natural light has a positive effect in academic performance while intense, unregulated sunlight has a negative impact [36,37]. Although the results do not particularly highlight the impact of air quality, there are studies that have directly linked it to the well-being of students [38,39].

These findings point to several relevant considerations for educational policy and school-level decision-making. First, the persistent structural and environmental limitations identified in traditional classrooms suggest that improving environmental quality should be understood as a prerequisite for pedagogical innovation, rather than as a secondary or aesthetic concern. Policies aimed at fostering innovative teaching practices need to explicitly incorporate environmental conditions, such as adequate space, thermal comfort, and lighting, as core components of learning quality and student well-being.

Second, the prioritisation of space for students as the primary focus for improvement, particularly in traditional settings, indicates that many schools continue to operate under spatial constraints that directly limit flexibility, movement and collaborative work. This reinforces the need for strategic planning at the centre level, where space allocation and use are reconsidered from a pedagogical rather than purely organisational perspective. Incremental interventions affecting all classrooms may be more impactful than isolated transformations of singular innovative spaces.

Finally, the prominence of temperature and light as priorities suggests a growing awareness of the role of environmental comfort in learning, in line with previous research [36,37]. By contrast, it is noteworthy that acoustic conditions were assigned a comparatively low level of importance when considering priorities for improvement, despite extensive evidence highlighting their impact on concentration, well-being, and learning outcomes [40-42]. This finding points to a potential gap between research evidence and teachers' perceived priorities, which warrants further attention. This growing awareness of certain environmental factors, and the relative neglect of others, should be leveraged by educational authorities through the development of clear guidelines and minimum standards for

environmental quality in schools, as well as through targeted investment in building refurbishment and climate adaptation measures.

Analysis of the teachers' knowledge to use the educational space
Overall, the findings suggest that experience in innovative learning spaces is associated with greater perceived competence in spatial planning, management, and pedagogical use of the physical environment. However, it is important to note that a substantial proportion of teachers in both groups report neutral or negative responses across the different statements. This may indicate that a considerable number of teachers do not perceive themselves as sufficiently competent in key aspects related to the pedagogical use, management, and planning of learning spaces, regardless of the type of environment in which they teach. This finding highlights an important gap between the growing emphasis on innovative learning environments and the professional knowledge required to exploit their full potential.

From a policy perspective, these results suggest the need to strengthen both school-level and administrative strategies for teacher professional development. Training programmes should move beyond isolated or voluntary initiatives and be embedded systematically within institutional policies, ensuring that all teachers, particularly those transitioning to or expected to work in innovative spaces, receive sustained and practice-oriented support. Such training should address not only the physical configuration of spaces but also classroom management, scheduling and pedagogical strategies aligned with flexible and non-traditional environments, as it was previously stated by Lozano, *et al.*[5]. At an administrative level, these findings underscore the importance of aligning investments in infrastructure with parallel investments in teacher training, as spatial transformation alone is unlikely to lead to meaningful pedagogical change without the necessary professional competences [2,43].

LIMITATIONS
This study presents several limitations that should be considered. First, the use of a non-probabilistic, voluntary sampling strategy limits the generalisability of the findings to the wider teaching population. Second, the data are based on self-reported perceptions, which may be influenced by subjective bias or social desirability effects. Third, the classification of teachers into traditional and innovative environments relies on self-identification, which may encompass heterogeneous practices and spatial conditions. Finally, some chi-square analyses were affected by low expected cell frequencies, suggesting that certain results should be interpreted cautiously and considered exploratory.

CONCLUSION
Overall, the findings of this study highlight the strongly interdependent relationship between space, furniture, environmental conditions, and teachers' professional competences in the promotion of educational innovation linked to the implementation and use of innovative spaces. Across contexts, there is a clear convergence in recognising the regular classroom and playgrounds as key spaces for pedagogical innovation, alongside a growing appreciation of transitional and flexible areas such as libraries, small group rooms, and hallways. However, while innovative learning spaces are associated with more diversified use of school spaces, furniture, and greater perceived teacher competence, significant structural, environmental, organisational, and knowledge-related barriers persist in both innovative and traditional settings. The results consistently indicate that pedagogical innovation cannot be sustained through isolated spatial redesigns or flagship projects alone, nor through teacher training detached from material conditions. Instead, effective and equitable innovation requires a systemic and coordinated approach that aligns incremental improvements to everyday classrooms, strategic investment in flexible and mobile furniture, enhancement of environmental quality, and sustained, practice-oriented professional development.

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