Public Education Policies: Ergonomic Aspects, Teaching Methodology and the Teaching and Learning Process

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The Barcelona Conference on Education 2024
Official Conference Proceedings

Abstract
This paper analyzes the influence of ergonomic aspects of classrooms on the learning process. The objective is to analyze the comfort and accessibility of classrooms, the teaching methodology and the teaching and learning process. In the school environment, there are spaces configured according to the Brazilian educational policy to meet the basic needs of educational institutions. The basic elements of analysis include furniture, equipment, environmental comfort (ergonomics), accessibility. The research methodology was bibliographic and documentary, descriptive, exploratory and quantitative. In addition, it involved the ergonomic evaluation of classrooms, evaluation of the space with regard to structural safety/accessibility. The research was conducted with students of the technical course in occupational safety in the northeast region of Brazil. The results showed that the ergonomic evaluation of classrooms is essential to identify and correct environmental discomforts, in accordance with the Technical Standards and Regulatory Standards NR-17 and public education policies. This study concludes that educational institutions must consider the individual needs of students, ensuring that the physical space favors not only cognitive learning, but also emotional and social well-being. The analysis of classroom comfort, together with traditional and/or active teaching methods, revealed the need for adjustments to provide an efficient and inclusive learning environment. Educational institutions must invest in adequate infrastructure and teaching methodologies that favor the integral development of students, ensuring a more equitable and inclusive education.

Keywords: Educational Policies, Ergonomic Comfort, Teaching Method, Learning

Introduction

Public education policies are essential to ensure quality education, covering not only pedagogical content but also ergonomic aspects, methodology, and the teaching-learning process (Kowaltowski, 2011). The influence of ergonomic aspects of classrooms on the teaching and learning process, contextualized within public education policies, aims to promote an inclusive democracy both in Brazil and worldwide. Educational institutions have adapted their buildings to meet the needs of social and cultural development, accessibility, and inclusion, reflecting a global movement toward equitable education (UNESCO, 2020). The objective is to analyze the comfort and accessibility of classrooms, the teaching methodology, and the teaching and learning process. In the school environment, there are spaces configured according to Brazil's educational policy to meet the basic needs of educational institutions (FNDE, 2023; Santos Pinheiro et al., 2017). School architectural models include different environments, such as administration, laboratories, libraries, common areas, and multi-sports environments (Sardinha et al., 2017; Amorim & Campos, 2022a). Basic elements of analysis include furniture, equipment, environmental comfort (ergonomics), accessibility, and fire prevention and fighting systems (Silva, 2023; Regulatory Standard 17, [NR-17], 2022). The methodology used involved an ergonomic assessment of the classroom and bibliographic and documentary research of a descriptive, exploratory, and quantitative nature. The research was carried out using a questionnaire in a class of 40 students of the technical course in occupational safety in the state of Pernambuco, Brazil (Gil, 2019; Marcone & Lakatos, 2017; Severino, 2017). The ergonomic assessment of the classroom is essential to identify and correct environmental discomforts, in line with the Brazilian Technical Standards NBR 9050/2020, which defines accessibility standards for buildings and furniture, and the Regulatory Standards NR-17 (Oliveira & Cavalcante, 2021; Iida & Buarque, 2021).

Democratic educational policies are essential to promote an inclusive and equitable educational system, both in Brazil and in other global contexts. They go beyond meeting basic needs, seeking to ensure equal educational opportunities for all, regardless of individuals' socioeconomic conditions (Crochick et al., 2020; Frigotto et al., 2014). In this sense, transformations in school buildings play a central role, contributing to social and cultural development and to the implementation of accessibility and inclusion, indispensable elements in a truly democratic and quality education (Sardinha et al., 2017). In this context, given the many challenges faced by the Brazilian education system, it is essential that public policies be integrated and coordinated, involving all levels of government and different areas of activity. According to Gadotti (2000), education needs to be viewed as a collective project, requiring coordination between infrastructure, teacher training and inclusive practices to guarantee the right to quality education. In this context, continuous investments are essential, including improvements to the physical conditions of schools, teacher training and the promotion of pedagogical methodologies that meet the sociocultural diversity of students (Saviani, 2008).

Furthermore, strengthening vocational education is a strategic path towards a more equitable society. According to Aranha (2020), valuing this type of education is crucial to expanding opportunities for access to the job market and fostering social development. These investments, aligned with educational inclusion policies provided for in the Law of Guidelines and Bases for National Education (LDB, Law No. 9,394/1996, 1996), ensure that all students, regardless of their socioeconomic background, have equal opportunities for success and comprehensive development.

Contextualization

The development of public policies in education is a central tool for ensuring quality education that encompasses not only pedagogical content, but also fundamental aspects such as ergonomics, teaching methodologies, and the teaching-learning process (Villarouco et al., 2015). According to Saviani (1992; 2008), these policies play a structuring role in promoting the democratization of access to education and ensuring conditions for students to remain in school and succeed. Legislation and specific programs support these initiatives. The LDB (Law No. 9,394/1996, 1996) establishes the fundamental principles and objectives for the organization of education in Brazil, highlighting the importance of harmoniously articulating teaching, research, and extension. Furthermore, programs such as the National Fund for the Development of Education (FNDE) work to finance projects aimed at school infrastructure and improving accessibility, as discussed by Oliveira and Cavalcante (2021) in their analysis of passive fire protection in school projects.

These initiatives reflect a commitment to building educational environments that ensure the well-being of students and teachers. Studies such as those by Ruas (1999) and Silva (2023) indicate that ergonomic comfort is a determining factor for the success of the teaching-learning process, while Moro (2005) highlights that the adequacy of school furniture can significantly influence students' health and performance. Such evidence reinforces the need to integrate policies that not only expand access to education, but also qualify teaching spaces and methods. Public policies and ergonomics in the educational context reflect the quality of the school environment and the impact on teaching and learning. Public policies in education that address accessibility, teaching methods, and comfort in the classroom are essential to ensure an inclusive, effective, and conducive environment for learning (Souza & Teixeira, 2019; Kowaltowski et al., 2005; Araújo et al., 2018).

Accessibility Policies

Educational accessibility policies aim to ensure that students with disabilities or specific needs have the same learning and participation opportunities as their peers (Dela Cruz et al., 2023; Toyinbo, 2023; Smith, 2012). Some measures include:

- School Inclusion: Laws such as the Brazilian Law for the Inclusion of Persons with Disabilities (Law No. 13,146/2015) ensure the right to inclusive education and access to the necessary resources so that students with disabilities can study in regular schools;
- Adaptation of Spaces and Materials: The policies provide for the physical adaptation of institutions, with ramps, elevators, Braille signage and appropriate furniture. They also include the provision of accessible teaching materials, such as Braille books, audiobooks and assistive technologies;
- Teacher Training for Inclusion: Many teacher training programs aim to train teachers to work with students with different needs, providing adaptive teaching that is sensitive to the specificities of each student;
- Policies on Teaching Methods: Policies involving teaching methodologies encourage the use of pedagogical practices that promote more active, relevant and inclusive learning.

Comfort and Ergonomics Policies in the Classroom

The physical environment has a direct impact on the concentration and well-being of students and teachers. Comfort and ergonomics policies seek to ensure that classrooms are suitable for learning (Oliveira & Cavalcante, 2021; Pinto et al., 2013; Ruas, 1999; Sanoff, 2001). Measures including infrastructure and ergonomics on school furniture, such as adjustable ergonomic tables and chairs, are essential for the physical comfort of students. The LDB requires schools to have an adequate, safe structure with school environments with leisure and communal areas, libraries so that students have spaces for rest and socialization.

Key Examples of Policies and Programs

Accessibility Program in Basic Education: Government program that provides for the adaptation of schools to make them accessible and the training of teachers to work with students with disabilities. The National Policy for Special Education in the Perspective of Inclusive Education promotes the inclusion of students with disabilities in regular schools and encourages the use of adaptive and inclusive teaching methods. The FNDE – National Fund for the Development of Education is responsible for resources for furniture, teaching materials and technology for schools, with the aim of improving the physical and ergonomic conditions of educational environments. The LDB (Law No. 9,394/1996, 1996) provides guidance on the organization of school spaces and the promotion of an adequate and comfortable learning environment. These public policies are essential for the development of accessible and quality education, promoting an inclusive environment, active methodologies and a physical space that favors the learning and well-being of all students.

Teaching Methodologies

The teaching methodologies adopted and developed in educational institutions involve diversified and adaptable approaches to the different needs of students, aiming to make learning more effective and meaningful. Studies by the authors (Capelletti, 2022; Reisslein et al., 2005; Palú et al., 2020; Luckesi, 2011). Among the most relevant methodologies by the authors are:

- Traditional Teaching: Based on lectures and centered on the teacher, it is a methodology that structures the content in a linear and hierarchical way. It is widely used, but has been complemented by more interactive methods;
- Active Methodologies: Such as problem-based learning (PBL) and project-based learning (PBL), which encourage students' autonomy and active participation in the construction of knowledge, promoting the development of critical and collaborative skills;
- Hybrid Learning: Integrates face-to-face teaching with digital and online resources, allowing learning to be personalized and optimizing classroom time for collaborative and practical activities; and
- Collaborative and Cooperative Learning: Focuses on group work and cooperation between students, developing social skills and collective learning.

Planned and contextualized educational methodologies are essential to ensure dynamic, inclusive teaching adapted to contemporary demands. Ongoing teacher training and the provision of adequate resources are essential steps for these practices to be consolidated in educational institutions. The development of active methodologies and the use of educational technologies are highlighted in national studies and policies, such as the National Common

Curricular Base (BNCC) and the objectives of the National Education Plan (PNE), which aim to prepare students for the challenges of the 21st century (Saviani, 2008; Valente, 2014).

The structuring of teaching environments that take into account pedagogical, technological and ergonomic aspects is essential. This includes the use of digital platforms, interactive tools and audiovisual resources that promote autonomous and collaborative learning. The FNDE (2023), through programs such as the National Book and Teaching Material Program (PNLD), has invested in technologies and materials that support this transformation. These practices are corroborated by studies such as those by Valente (2014), which highlight the importance of communication mediated by digital technologies in contemporary education.

In this context, teachers act as mediators and facilitators of knowledge. Methodologies such as flipped classrooms, interdisciplinary projects, and problem-based learning (PBL) depend on robust teacher training. According to Freire (1996), teachers must encourage critical thinking and student autonomy, aligning themselves with pedagogical practices that integrate reflection and action. Programs such as the National Pact for Literacy at the Right Age (PNAIC) reinforce ongoing training for educators, while recent studies, such as those by Palú et al. (2020), analyze the challenges faced by teachers, especially in the use of technologies during the pandemic.

Inclusion and methodological flexibility in inclusive practices are essential to meet the diverse realities of students. The National Policy on Special Education from the Perspective of Inclusive Education, for example, seeks to promote methodologies that respect cultural and socioeconomic differences and the specific needs of students (Saviani, 1992). Studies such as those by Oliveira and Cavalcante (2021) highlight how architectural and ergonomic planning also impacts inclusion and student performance. The application of these methodologies requires assessments that transcend traditional tests. Strategies such as portfolios, self-assessments and frequent feedback allow for closer monitoring of student progress and enable adjustments in pedagogical practices (Saviani, 2008). These approaches are advocated by Sanoff (2001) in his studies on school environments and by the National Education Plan, which encourages comprehensive training and practical skills. In the current changes in the world that are constantly transforming, methodologies that promote critical thinking, adaptability and collaboration are essential. In addition to preparing students for the job market, they contribute to the exercise of citizenship and ethical and responsible action in society. These ideas are addressed by Smith (2012) in his study on the impact of acoustics on learning environments and by Toyinbo (2023), who highlights how the physical environment affects academic performance (Palú, Schutz & Mayer, 2020).

Environmental Comfort and Ergonomics in the School Environment

Ergonomics applied to education examines the interaction between school structure and students' physical and cognitive aspects, covering everything from the environment and furniture to pedagogical methods and teaching materials. An inadequate school environment can compromise students' performance and health, highlighting the need for ergonomic and comfortable structures. Recent studies highlight that environmental factors such as temperature, lighting, ventilation and acoustics directly influence learning, highlighting the importance of a school design centered on well-being (Kroemer & Grandjean, 2005; Toyinbo, 2023; Dela Cruz et al., 2023).

It is not only pedagogical resources that determine the success of the educational process. School furniture, adjusted to the anthropometric measurements of students, combined with adequate environmental conditions, promotes not only greater comfort, but also better academic performance. Moro (2005) argues that inadequate furniture can lead to postural and visual problems. Similarly, Kowaltowski et al. (2005) reinforce that thermal and acoustic comfort are essential to maintain concentration and avoid fatigue.

At the international level, initiatives such as the Collaborative for High Performance Schools (Reisslein et al., 2005); Eley, 2006) define a high-performance school as one that adopts contemporary construction and design strategies, ensuring healthy, comfortable, sustainable and safe environments. In Brazil, concerns about environmental comfort and ergonomics in education are reflected in documents such as the Basic Infrastructure Parameters for Early Childhood Education Institutions (MEC, 2006) and the Educational Spaces for Elementary Education: Support for the Development of a Project with Adaptation of School Buildings with an approach and guidelines for projects with accessible and ergonomic educational spaces (MEC, 2002).

- Lighting and Visual Cognition: Inadequate lighting can significantly compromise academic performance and the well-being of teachers and students. According to Millanvoye (2007), insufficient or excessive light causes visual fatigue and disturbances in the nervous system, reducing productivity. Classrooms, as work and learning spaces, must adopt ergonomic standards that ensure adequate lighting to avoid risks (Tavares, 2000).
- Thermal Comfort: Inadequately heated environments affect concentration and alertness. Studies by Kroemer and Grandjean (2005) indicate that excessive heat causes drowsiness and fatigue, while very low temperatures impair performance. Therefore, school buildings should be designed to ensure thermal comfort, regardless of external conditions.
- Acoustic Comfort: Noise interferes with attention, memory and speech comprehension, making learning difficult. NR-17 (2021) highlights the importance of acoustically controlled environments for activities that require constant attention. Studies such as that by Smith (2012), at Sweyne Park School, show that classrooms with good acoustics improve communication and reduce teachers' vocal effort, favoring academic performance.
- Ergonomics and Infrastructure: School furniture must meet the anthropometric needs of students to avoid postural problems and increase comfort. According to Moro (2005), inadequate furniture is responsible for discomfort that compromises students' performance and health. Standards such as those established by the MEC (2006), NBR and the Collaborative for High-Performance Schools (Eley, 2006) highlight that high-performance schools use modern design practices to create healthy and inclusive environments.

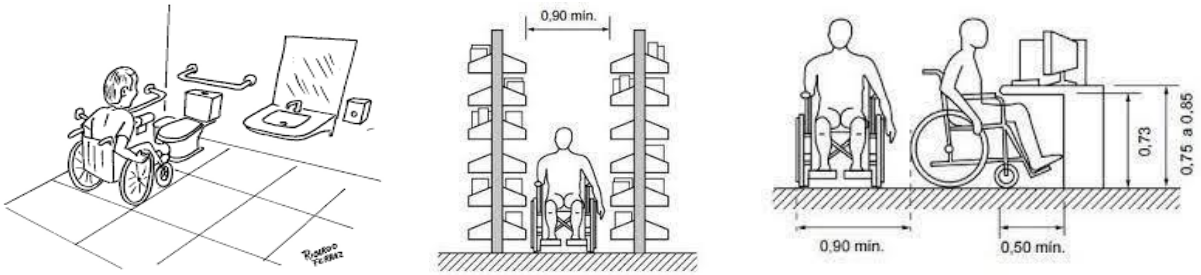

Figure 1: Accessibility in the School Space
Notice: Taken from ABNT NBR 9050 (2015)

Accessibility and Inclusion

The lack of accessible infrastructure, such as ramps, elevators and adapted bathrooms, still represents a barrier for students with disabilities. Assistive technologies, adapted furniture and inclusive teaching materials, such as those suggested by Conceição and Lúcio (2011), are essential to ensure educational equity. Government programs, such as the Basic Infrastructure Parameters for Early Childhood Education (MEC, 2006), seek to standardize these adaptations in public schools (Santos & Spinelli, 2007).

(A) (B)

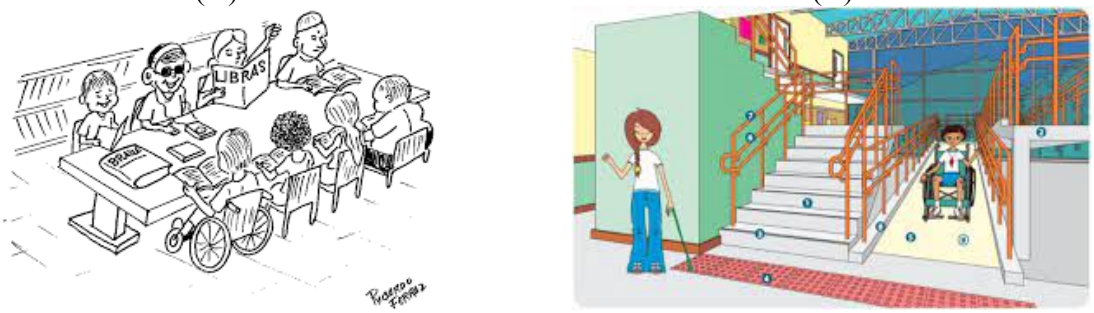

Figure 2: Space for Inclusion and Accessibility
Notice: Taken from Rojas & Rodrigues (2021)

Impact on the Teaching-Learning Process

Inadequate environmental physical factors, such as lighting, temperature and acoustics, directly contribute to fatigue, distraction and poor concentration. According to Kowaltowski et al. (2005), improving these conditions directly impacts the performance and well-being of everyone involved in the school environment.

Results and Data Analysis

The research results were carried out through a questionnaire in a class of 40 students of the technical course in occupational safety at the Federal Institute of Pernambuco, Brazil. Only 21 students responded to the questionnaire. An ergonomic assessment of the classroom was carried out to reach the aspects of comfort, accessibility and the structure of space (Gil, 2019; Marcone & Lakatos, 2017).

In Figure 3, we can observe the space that was analyzed and the comfort aspects (temperature, noise and lighting). The furniture, furniture arrangements and the type of teaching methods applied in the classroom at the school under study were also analyzed.

Figure 3: Structure of the Furniture Organization of the School in Pernambuco/Brazil
Notice: Records made by the authors (2024)

In Table 1, we present comfort parameters according to the Regulatory Standard – NR-17 and the Brazilian NBR 10152 (ABNT, 1987) registered with INMETRO.

Table 1: Assessment of Comfort Aspects in the Classroom

Comfort Parameters	Measured values	Action
Lighting 300-500 lux	235 lux	Perform adjustment
Temperature 20°C - 23°C 68°F - 73.4°F	21°C 69.8°F	No action
Noise Up to 65 dBA	76 dBA	Perform adjustment

The parameters are:

a) The maximum noise level allowed in a classroom is 40 decibels (dB). Anything above this level can cause learning disabilities and vocal problems for teachers. Knowing the possible consequences of a noisy classroom, in which speech intelligibility is impaired, it is necessary to carry out an assessment in the classrooms due to these factors.
b) The effects of classroom temperature and the ideal effective temperature index between 20°C (twenty) and 23°C and with relative humidity of 40 to 60% were analyzed, where the air speed should not exceed 0.75 m/s, according to NR-17 (2022) and the author Iida (2001). The temperature can cause discomfort and have a direct impact on the development of learning, the ability to concentrate on carrying out activities, as well as fatigue, fainting, dehydration, intense sweating, and headache.
c) Environmental lighting is fundamental for the performance of activities and NBR ISO/CIE 8995-1 (2013) and NR-17 (2024) determine standards for environments. The environment analyzed in this research was the classroom. NBR establishes the standard lighting for educational buildings between 300Lux and 500Lux for the classroom and that the lighting is controllable, such as: nighttime classrooms, adult education, reading room (Passarin, 2019; Cruz et al., 2024).

In Figures 4, 5 and 6, below, the data found in the response forms (questionnaire) on comfort in the classroom such as noise, temperature and lighting were analyzed.

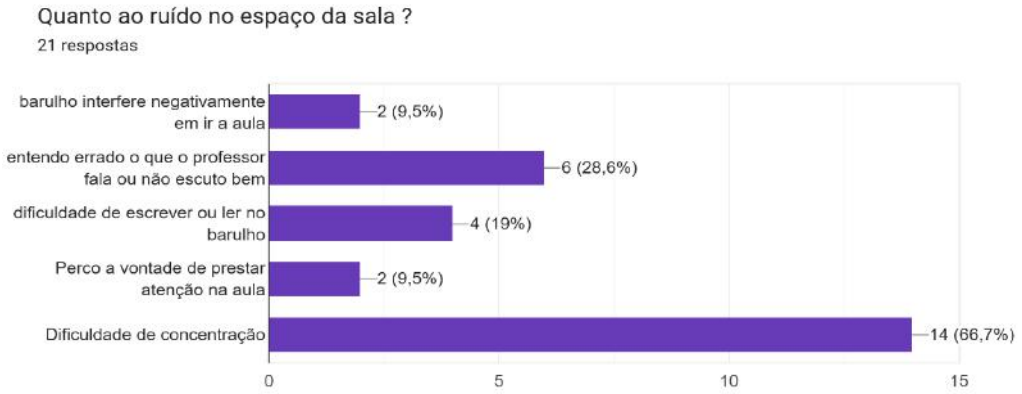

Figure 4: Analysis and Results: Impact of Noise in the Classroom

The responses indicate that classroom noise affects students' learning qualities in several ways. The main impact identified was difficulty concentrating, reported by 66.7% of participants (14 students). This data reflects the importance of acoustic control in the school environment to ensure adequate learning conditions, as pointed out by Araújo et al. (2018), who emphasize that the physical environment directly impacts student performance.

Other reported effects include difficulty understanding what the teacher is saying (28.6%) and difficulty performing tasks such as reading and writing in a noisy environment (19%). This situation reinforces the findings of Santos & Souza (2020), which indicate that excessive noise compromises both auditory processing and cognitive skills related to reading and writing. In addition, 9.5% of students (2 responses) stated that they lost the desire to pay attention in class, highlighting the emotional impacts of noise, as suggested by Lima and Barbosa (2021).

To mitigate these problems, the literature recommends disciplines such as:

a) Structural improvements: Implementation of acoustic materials on walls and ceilings to reduce sound reverberation (Souza et al., 2017).
b) Behavioral management: Encouraging rules of coexistence to minimize unnecessary noise during classes (MEC, 2006); and
c) Technological resources: Use of sound amplification systems, such as microphones and speakers, to improve audibility (Luckesi, 2011; Amorim & Campos, 2022a).

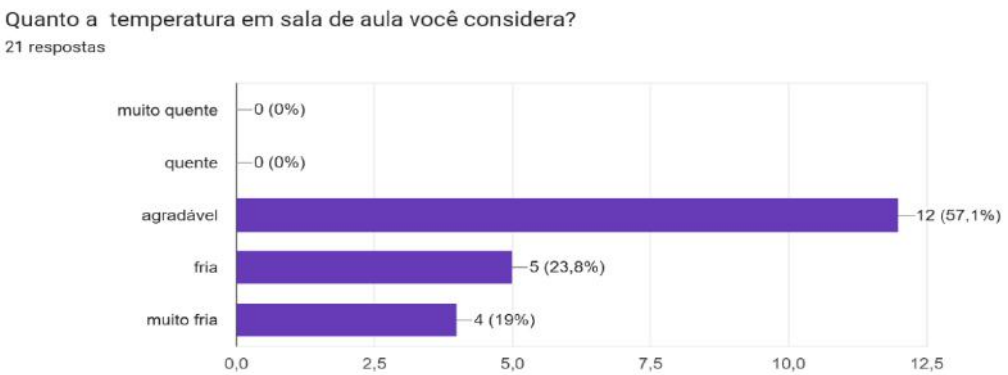

Figure 5: Analysis and Results: Perception of Temperature in the Classroom

In Figure 06, the perception of the temperature in the classroom, obtaining the following results: Pleasant: 12 students (57.1%); Cold: 5 students (23.8%); Very cold: 4 students (19%). These results indicate that, for most students, the temperature in the classroom is perceived as pleasant, which suggests adequate conditions in terms of thermal comfort for more than half of the interviewees. However, a significant portion of the participants (42.8%) experienced discomfort, either because the environment was cold or very cold, indicating the need for adjustments in the temperature in the classroom.

In the discussion of the results, the perception of thermal comfort is directly related to productivity and learning. According to Souza et al. (2021), the ideal temperature in school environments should allow students to maintain attention without distractions or physical discomfort, which can impact academic performance. When the environment is considered cold or very cold, there may be a reduction in overall comfort and engagement with activities, as suggested by studies by Luckesi (2011).

Studies by Amorim & Campos (2022b) also reinforce that comfortable temperature conditions, whether high or low, affect students' levels of concentration and well-being, especially during prolonged class periods. For 42.8% of the responses that demonstrate discomfort, it is important for the school to make its ventilation or air conditioning systems effective, seeking thermal balance in all rooms in accordance with standards NR-17 (2022) and NBR 16401-2 (ABNT, 2008). Assessing thermal comfort should be an integral part of school planning to improve the quality of the learning environment. Environments with moderate temperatures favor student participation, while thermal extremes can increase feelings of tiredness or demotivation (Araújo et al., 2018).

Figure 6: Analysis and Result: The Impacts of Lighting in the Classroom

Analysis of the data from the graph on the impacts of lighting in the classroom reveals that, among the 21 responses collected, glare is indicated due to the natural lighting of the environment that reflects on the board and due to the lack of curtains or film, which results in excess light. On a smaller scale, 2 students (9.5%) said that the problem is the lack of curtains or film, which suggests that the intensity of natural light may be excessive. Excessive or poorly distributed lighting in the classroom can cause not only visual discomfort, but also eye fatigue, decreased concentration and difficulty in following the activities and content displayed on the board (Silva, Souza & Oliveira, 2016; Ramos & Oliveira, 2017).

Studies indicate that adequate environmental quality is a crucial factor for students' well-being in the classroom. As indicated in the studies by Silva, Souza and Oliveira (2016), lighting has a direct impact on concentration and content visibility, and visual comfort is

essential for effective learning. According to Ramos & Oliveira (2017), the lack of control and direction of light can affect the quality of lighting, causing discomfort and impairing the learning experience. Controlling the intensity of light directly affects these studies, and can increase the efficiency of pedagogical activities, allowing students to better understand the content. Costa and Silva (2014) state that light control strategies, such as curtains or films, can ensure a more comfortable and safe environment. Therefore, based on the results presented and the references mentioned, it can be concluded that adjustments in classroom lighting, such as the use of curtains, films or indirect lighting, are necessary to improve the quality of the environment and ensure comfort and promote a more inclusive and effective environment so that all students can concentrate and develop their activities.

(THE)

(B)

Elements used in the space	Elements found	Action
Teaching methodology applied	Active methodologies	No action
Types of Arrangement	Groups of 5 students	No action
Flow	Moving difficulty between groups	Adjustment required

(W)

Indicated area per student (m^2) and teacher	Allowed number of students in the classroom	Classroom size and student number	Intervenção
1.20 each student	35 students	49 m^2 – 35 student	Necessary intervention
5.00 each teacher	-	-	It should be 25 stds.

Figures 7: Teaching Methodology and the Teaching and Learning Process

The teaching methodology applied at the school of study at the Instituto Federal de Pernambuco (IFPE), on the Abreu e Lima Campus, is characterized by elements typical of active methodologies. The focus is on developing pedagogical practices that promote procedural, formative and continuous learning. These practices prioritize activities that involve investigation, confrontation and problem-solving, establishing an environment in which the student assumes a role and is encouraged to solve real problems and build knowledge through interaction and practice. The number of students in the classroom can also hinder involvement in the teaching and learning process as well as in the teaching method applied (Riffel & Malacarne, 2010; Bacich & Moran, 2017).

Figure 8: Analysis and Results: Chart on Desk Arrangement

The research sought to understand students' preferences regarding the arrangement of desks in the classroom. Of the respondents, 21 opted for the traditional model of chairs in rows facing the teacher. This number reflects a significant acceptance of conventional arrangements, which prioritize an organization centered on the teacher as the main transmitter of knowledge. The row model is widely used for its practicality and for facilitating individual concentration, reinforcing teaching methods focused on expository classes. Despite its functionality in traditional settings, this arrangement can limit interaction and the application of active methodologies, which require greater flexibility in school environments. Thus, its popularity highlights the balance between tradition and functionality in the educational environment. This configuration is also frequently adopted due to factors such as physical space limitations in many schools and the Brazilian educational culture, which historically values hierarchical structures centered on the figure of the teacher as the main mediator of knowledge.

This arrangement tends to hinder collaborative activities, such as group work or debates, restricting the implementation of active methodologies that favor student participation and the development of skills such as critical thinking and communication. Furthermore, in inclusive contexts, classrooms organized in a fixed way may not adequately meet the needs of students with disabilities, compromising accessibility and equity in learning (Luckesi, 2011; Amorim & Campos, 2022b; Souza et al., 2021).

Studies suggest that alternative formats, such as circular or U-shaped arrangements, promote greater interaction and engagement, facilitating both collaborative learning and inclusion (MEC, 2006). In this sense, adopting mobile furniture or flexible environments that can be quickly rearranged allows for different pedagogical activities and teaching styles to be met. In addition, adapting the physical space to new pedagogical and technological demands contributes to the creation of a more dynamic, inclusive and innovative educational environment (Araújo et al., 2018).

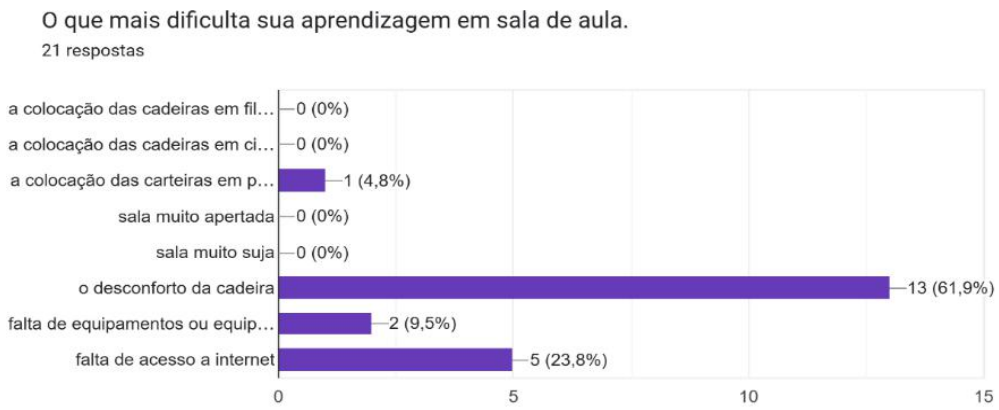

Figure 9: Analysis and Results: Learning Difficulties in the Classroom

Analysis of the collected data reveals the main factors that hinder learning in the classroom.

The results show the following panorama: Desk discomfort: This was mentioned by 13 students, representing 61.9% of the responses. This data highlights the inadequacy of school furniture as the main problem faced by students, reinforcing the importance of investments in ergonomics to improve well-being and academic performance (Moro, 2005). Lack of internet access: Cited by 5 students, equivalent to 23.8% of the responses. This issue reflects the need for connectivity in a teaching environment increasingly integrated with digital technologies, especially for research and access to support materials (Freire, 1987; Souza et al., 2021). Lack of equipment or staff: Mentioned by 2 students (9.5%), this problem highlights gaps in the school infrastructure that can limit the practice of modern and interactive pedagogical activities (Sardinha et al., 2017; Vasconcelos et al., 2021; Souza, 1998). Desk arrangement: Only 1 student (4.8%) pointed out this factor as a difficulty. Although it is a minority, this response may reflect the perception that more dynamic or collaborative arrangements can improve interaction and learning in the classroom (Luckesi, 2011; Bacich & Moran, 2017).

Therefore, the graph shows that most of the problems are related to the physical environment and infrastructure, with uncomfortable desks being the biggest obstacle. This finding reinforces the need for adaptations in school furniture to meet different body types and improve ergonomics (ABNT, 2021; NR-17, 2022). In addition, connectivity and the provision of equipment should be prioritized to align teaching with contemporary demands. Finally, although the arrangement of desks was rarely mentioned, it complements the reflection on how the physical environment can influence the teaching-learning process. These data suggest that structural and technological interventions are essential to create a more inclusive and efficient environment, aligned with the needs of students.

Table 2: Assessment of the Space With Regard to Structural Safety/Accessibility

Structural safety aspects / accessibility	Intervention	Action
Tactile floor	Yes	Install tactile flooring
Signpost	Yes	Install signpost
Accessible door 0.90m wide	It needs adjustment	Install accessible signage and latches
Mural 1m from the floor	Yes	Install mural
Wall and floor contrast	It needs adjustment	Paint wall contrasting with floor
Height from floor to blackboard 1m	Not necessary	None

Installation of Tactile Flooring. According to NBR 9050 (2020), the installation of tactile flooring is essential to ensure accessibility for people with visual impairments. Tactile flooring should be applied in circulation and direction-changing areas to facilitate safe movement. The proposal to install tactile flooring is aligned with regulatory requirements. This intervention is crucial to promote the inclusion and autonomy of users with visual impairments, ensuring that they can move safely through the space. The installation of adequate signage, according to the guidelines of NBR 9050 (2020), is essential to guide and inform all users of the space, especially those with special needs (Law 13,146,2015; Costa & Souza, 2019).

Conclusion

This study reinforces the importance of adapting school buildings to meet the social, cultural and educational demands of the 21st century, with a focus on accessibility, inclusion and environmental comfort. The analysis of school spaces revealed the need to invest in adequate infrastructure and adopt innovative teaching methodologies, which are essential steps to ensure the integral development of students and a more equitable education. These initiatives need to be aligned with contemporary pedagogical demands, promoting a physical space that stimulates concentration and well-being. Finally, the implementation of structural and methodological improvements requires collaboration between schools, administrators, authorities and governments. Only with sets of exercises will it be possible to create an educational system that fully meets the needs. It is crucial to emphasize that classroom configurations must not only meet infrastructure and comfort standards, but also align with emerging pedagogical practices that promote active and collaborative learning. For example, the use of flexible and adaptable spaces allows the implementation of methodologies that stimulate student engagement and participation in practical activities. Furthermore, engagement is another relevant point and the need for public policies that encourage continuous funding for improvements in infrastructure and teacher training, allowing schools not only to correct flaws but also to innovate in teaching processes. In this way, it becomes possible to meet the diversity of students and the different learning demands in the contemporary context. Therefore, the path to inclusive and quality education requires joint efforts to create school environments that are safe, comfortable, and pedagogically and technologically advanced. Only in this way will it be possible to meet the expectations of the 21st century, ensuring that each student has the opportunity to reach their full potential in a space that promotes well-being and effective learning.

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