

Ergonomic design in Algerian educational institutions from the perspective of teachers

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Abstract: This study aimed to reveal the reality of ergonomic design in Algerian educational institutions from the perspective of teachers, as well as to identify differences in attitudes towards ergonomic design in Algerian educational institutions according to the variables of building location and building type. The study was conducted in some middle schools in the city of Mascara in western Algeria. The descriptive analytical method was used in the study. The sample consisted of 77 male and female teachers, selected purposively, who were given a questionnaire on the reality of ergonomic design in educational buildings. The data were processed using the Statistical Package for the Social Sciences, and the results revealed that the reality of the ergonomic design of Algerian educational institutions from the point of view of middle school teachers is positive. It also concluded that there are statistically significant differences in attitudes towards the ergonomic design of Algerian educational institutions according to the variable of building location, in favor of urban education buildings, and that there are no statistically significant differences in attitudes towards the ergonomic design of Algerian educational institutions according to the variable of building's age.

Keywords: design; ergonomics; teachers; educational institutions; middle school.

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1 - Introduction

After the great development in educational work in various school stages and in various curricula and educational programs, the focus has become on the productivity and effectiveness of educational work more than its contents, especially after the widespread dissemination of the concept of educational standards, as indicated by the study of Yamani and Zaqaar (2017) on the physical space of the school environment and its relationship to negative attitudes towards the school, as well as the study of Sulaimani (2011) on the architectural design of the school environment and its role in shaping violent behaviour among students, in addition to the study of Zieschang, H et al (2017), which concluded that the familiar basic principles of ergonomic design should be applied in learning spaces and classrooms.

Therefore, a new field has emerged in the educational arena, whose importance increases over time, coinciding with the development of educational means and equipment, such as the study of Hamdache(1995) on the anthropometric evaluation of school desks for first and second year middle school students, the study of Mansouri on the design of the school chair and desk mentioned by Mansouri and Boudali (2017), as well as the study of Bakrawi(2008) entitled an ergonomic study of the study position in middle school education. Interest has increased widely on the interactive environment in which the educational process takes place, because the degree of success of the educational process is mainly related to the suitability of the environment in which it takes place, a study of Omari, S., Woodcock, A., & Ball, T. (2011) found that the built environment has a direct impact on student achievement and facilitates teaching and learning. Environmental conditions such as building age, heating, lighting, air quality, noise, color use, furniture type, room layout, and density were associated with significant and measurable changes in student achievement and performance. The built environment also influences the school climate, which in turn affects students' morale, values, aspirations, expectations, and performance, and this is a field of intervention of work and organizational psychology in general and ergonomics in particular, according to Mbareki (2008), after it was limited to industry, work canter, equipment and means in the industrial environment.

However, the term of educational ergonomics has recently emerged, mainly due to the expansion of ergonomic interests in various human fields without exception. In the educational field, we now find most studies separating ergonomic interventions in the educational field to include various aspects of educational action, such as the ergonomics of educational programs, which includes the design of the teaching process and training and development programs, one such study, by Zieschang, H et al (2017), on ergonomic classroom management, concluded that classrooms in schools promote good health when they give schoolchildren and teachers greater control over their well-being, and that classrooms are conducive to learning when they support the acquisition of knowledge and skills, thus having a positive impact on the learning process, and the ergonomics of the educational environment, which includes the physical educational environment, the social environment, the cultural environment, and even the administrative environment. Likewise, the application of ergonomic strategies has expanded in the field of monitoring and evaluation, especially in the design of school buildings and even pedagogical means and equipment.

Therefore, this study will examine the suitability of the school environment in general for educational activities in some schools by monitoring the organizational, physical, and cognitive environments, as well as identifying the soundness of the internal and external design of classrooms. Therefore, the study seeks to answer the following questions:

- What is the reality of ergonomic design in Algerian educational institutions from the perspective of middle school teachers?
- Are there differences in the level of ergonomic design in Algerian educational institutions, from the perspective of middle school teachers, based on the building's location (urban area, semi-urban area)?
- Are there differences in the level of ergonomic design in Algerian educational institutions, from the perspective of middle school teachers, based on the building's age (old, new)?

1.1- Study hypotheses:

- The ergonomic design of Algerian educational institutions, from the perspective of middle school teachers, is generally positive.
- Differences exist in the perceived level of ergonomic design in Algerian educational institutions, as perceived by middle school teachers, attributable to the building's location (urban, semi-urban).
- Differences also exist in the perceived level of ergonomic design in Algerian educational institutions, as perceived by middle school teachers, attributable to the building's age (old, new).

1.2- Study Objectives:

This study aims to achieve the following objectives:

- To identify the reality of ergonomic design in Algerian educational institutions from the perspective of middle school teachers.
- To identify the differences in the level of ergonomic design in Algerian educational institutions from the perspective of middle school teachers, according to the variable of building location (urban area, semi-urban area).
- To identify the differences in the level of ergonomic design in Algerian educational institutions from the perspective of middle school teachers, according to the variable of building type (old, modern).

1.3- Study Importance:

The importance of this study lies in determining the level of ergonomic design in Algerian educational institutions and its suitability for educational practice from the perspective of middle school teachers, and in contributing to isolating external variables that could negatively affect the performance of the educational system.

It also aims to help disseminate the healthy and comfortable environmental culture that is the goal of proper ergonomic design for buildings, classrooms, and various pedagogical tools and resources.

Furthermore, it opens the door to expanding ergonomic studies in the educational environment and establishing specific ergonomic standards that encompass all aspects and areas that can contribute to the quality of the educational system.

2- Theoretical framework:

2.1- The concept of ergonomic design for schools:

Ergonomic design of a school encompasses all aspects of ergonomic applications within the school environment. Karwowski, W., & Goonetilleke, R. S. (2019) stated that ergonomics is concerned with designing products, processes, services, and work systems to ensure their productive, safe, and satisfactory use by people. Physical ergonomics involves designing work environments to suit human physical capabilities by understanding the limitations and capacities of the human body and mind. Therefore, according to Mahali and Dahmani (2024), ergonomic design of a school is the field that addresses aspects such as hygiene, safety, physical conditions, and well-being within the school environment, thus representing ergonomic intervention in the school setting. Sirat

& Bakkar (2019) stated that design ergonomics includes all interventions related to the physical aspects of working within the school, such as lighting, ventilation, temperature, and the arrangement of learning spaces. It also considers the physiological aspects and anthropometric measurements of both teachers and students, and their suitability to the activities they perform and the tools they use.

In addition, Bounouiqa & Boukhit (2020) define the ergonomic design of the school as the art of planning the various material or physical components of the school, starting from its location and then its internal contents, including the school building and what it contains of halls, laboratories, educational means, gardens, administration offices, and various service, recreational and health facilities. Mahali & Dahmani (2024) add that the ergonomic design of the school is in fact the application of the principles of ergonomics in the school environment, especially the study of the appropriate physical conditions to achieve the psychological and physical health of all actors in the school space.

2.2- Objectives of ergonomics in school:

LEPLAT (1980) considers that the goal of ergonomics as a technology is to improve, organize and design a human-machine system. However, Muslim (2007) believes that this perception reduces the boundaries of the fields of ergonomics in that we cannot imagine any human activity that goes outside the framework of this interaction, whether this interaction is in working life, study, family social life, etc.

Therefore, ergonomics generally seeks to achieve three goals: comfort, efficiency, and safety. Mbareki (2004) stated that, given the constant change in the work environment, ergonomics seeks to make its three goals compatible, even though they appear contradictory. It aims to study the human being and his environment and to pay attention to the interaction between them by creating healthy and productive conditions for school workers, as well as making the school environment consistent with the needs, abilities, and readiness of individuals in the school space, thus achieving maximum comfort for them, considering that he is a biological being who enjoys psychological, social, and anthropometric characteristics. In addition, school ergonomics aims to organize the school environment according to ergonomic design principles, which leads to increasing the effectiveness and efficiency of the teacher by improving work methods, improving and organizing work spaces and their basic components, and making them suitable for the teacher's abilities and capabilities.

The ergonomic design of schools aims to achieve educational objectives, as demonstrated by the study by Bouneouika & Boukhit (2020). This is done by considering the various functions of the school building and the local cultural, social, and economic characteristics of the area where the building is located. Furthermore, urban planning objectives can be incorporated into school ergonomic design by focusing on how the educational building is integrated into its environment, whether in a village or a city, while also considering ease of access to the educational institution and available transportation. In addition, there are environmental objectives for school ergonomic design, which include respecting the natural environment, conserving energy and resources, ensuring comfort, and addressing health concerns.

2.3- School design standards:

Omari, S., Woodcock, A., & Ball, T. (2011) stated that despite the extensive investment in education, there are few guidelines guiding the design of primary schools, even though all evidence points to the importance of the physical school environment in helping children achieve their academic potential and providing suitable working

conditions for staff. Therefore, in this section, we will discuss some criteria to guide the design of school buildings as follows:

-School construction site:

The appropriate location for building a school contributes to supporting the educational process, as it allows easy access for teachers and learners. Bounouiqa and Boukhit (2020) mentioned a set of basic criteria that must be available in the location of the institution, the most important of which is that the location of the new building is in the direction in which the city is expected to grow, that it is a large area that can accommodate all educational activities and allows for the addition of new buildings when needed, that the building is in the middle of current or future population centers, that transportation is easy to and from the new building, that it is close to some service centers and far from places of pollution, noise, railways and busy roads.

- School's interior space quality:

Ergonomically designed interior space allows for smooth internal movement in the school, as reported by Obrahim (2021), who stated that the ergonomic design of the walkways helps to facilitate movement, prevent overcrowding, and avoid collisions of students. Its design depends on determining the width and length of the walkways for movement according to the number of students and the security standards for evacuating the building during emergencies or fires. The quality of the school's interior space can also be determined through a set of standards such as lighting, ventilation, noise, and the colors used in painting classrooms and courtyards.

Lighting plays a major role in educational functionality. Khader (2020) stated that the student needs a comfortable view in the classroom to perceive what is around him. Therefore, ergonomic design standards must be respected to design a comfortable view that allows for the perception of masses and their formation and has a positive moral and psychological effect.

Regular ventilation of classroom sections is also considered a contributing factor to the child's good comprehension. A study by Hafri (2016) stated that air pollution with carbon dioxide due to the lack of air renewal inside the sections and the lack of oxygen leads to a lack of concentration, headaches, a feeling of suffocation and nausea. This requires the presence of ventilation ducts or opening windows from time to time, especially during rest periods and when students go out to the yard. This necessitates the presence of windows on both sides of the section to accelerate the process of air renewal.

Regarding noise, a quiet school environment is one of the most important requirements for the success of the educational process. As Obrahim (2021) stated, it provides the space for focus and attention, leading to better learning for the child and enabling them to comprehend and understand all the words spoken by the teacher and students in the classroom. It also allows the teacher to maintain their health and avoid strain, as they may be forced to raise their voice in a noisy environment, potentially causing injuries to their vocal cords. Therefore, the World Health Organization (WHO) recommends that noise levels in educational classrooms should not exceed 35 decibels, especially since the nature of educational tasks requires quiet for proper listening, reception, and comprehension of the information presented by the teacher.

In addition to all that, according to Sulaimani (2011), the colors used in painting classrooms and courtyards are among the visual elements of great importance because of the energy they carry with a visual content that affects sensory and mental perception, through which the aesthetics of the interior design and the integration of its performance, functional and expressive elements are felt. Colors affect the psyche, causing sensations

that result in a meaning that suggests ideas that may evoke comfort and tranquility or disturbance and emotion.

-School's external environment quality:

The most important feature of the external surroundings of school buildings is the external facade. In a study by Bouneouika and Boukhit (2020), it was stated that the design of external facades is one of the important design considerations that has a reflection on the psychological aspect of the institution's visitors, as the facade gives the first impression of the school's status, as the external facade gives the school a special character as an educational space compared to other institutions in its vicinity, whether in terms of the nature of the building, the external image, the gate, or the colors used in the paint.

In addition to the importance of external facades in the quality of the external environment, the external courtyards of the educational institution can be considered a very important space. The courtyard, playgrounds, and green gardens cannot be overlooked in the formative, educational, pedagogical, or psychological process, as the features of greenery and nature positively stimulate the mental and psychological aspect.

3- Method and Tools:

3.1- Method:

The current study adopted the descriptive exploratory approach, which allows for identifying the reality of the ergonomic design of Algerian educational institutions from the point of view of middle school teachers.

3.2- Sample:

The current study included 77 male and female teachers, belonging to middle schools in the city of Mascara in western Algeria, who were selected purposively. The study instrument was applied to them, and the following table shows the distribution of the sample members according to the study variables: building location, building age.

Table No. (01): the distribution of the sample according to the study variables.

Variable	Characteristic	Frequency	Percentage
building location	Semi-urban	37	84.1%
	Urban	40	51.9%
building age	Old	52	67.5%
	Modern	25	32.5%

Table No. (01) shows a balance between the groups of the school building location variable, while we observe a disparity between the groups of the building age variable, which can be explained by the low number of modern schools.

3.3-Tool:

The researchers designed a questionnaire that measures professors' attitudes towards the ergonomic design of educational institutions. This was done after reviewing the literary heritage of the subject and some studies and scales on the subject in Arabic and foreign studies. The questionnaire included 25 items, and the answer is given using a five-point Likert scale by choosing one of the following five alternatives: strongly agree, agree, neutral, disagree, strongly disagree. The responses are corrected using the following weights: (1, 2, 3, 4, 5), as the scores range from 25 to 125.

-Validity:

To verify the validity of the questionnaire, internal consistency validity was calculated to determine the correlation between the dimension and the total score. The following table illustrates this:

Table No. (02): the values of the internal consistency validity coefficients

Item	Correlation	Item	Correlation	Item	Correlation
1	0,717**	9	0,666**	17	0,770**
2	0,689**	10	0,549**	18	0,624**
3	0,443**	11	0,531**	19	0,632**
4	0,620**	12	0,341**	20	0,536**
5	0,572**	13	0,593**	21	0,694**
6	,590**	14	0,692**	22	0,650**
7	0,579**	15	0,620**	23	0,575**
8	0,603**	16	0,238*	24	0,599**

** Significant at a significance level of α 0.01

Table No. (02) shows that the correlation coefficients between the total score and the questionnaire items were statistically significant at the significance level of 0.01, and they are high and significant, as they ranged between the lowest value 0.238 and the highest value 0.770.

- Reliability:

The reliability of the questionnaire was confirmed using Cronbach's alpha equation, where its value for the overall scale was 0.916. The value of the reliability coefficient through split-half reliability was 0.740, and after correcting the value using the Spearman-Brown equation, it was 0.844. This indicates that the questionnaire has high validity and reliability coefficients, which justifies its suitability for use in this study.

3.4- Statistical methods:

To process the data obtained in the study, the Statistical Package for the Social Sciences (SPSS20) was used. The statistical methods used were the percentage, Cronbach's alpha coefficient, Pearson's correlation coefficient, and the t-test for the significance of differences.

4- Results and Discussion

4.1- First hypothesis:

It stated that the reality of ergonomic design of educational institutions from the point of view of middle school teachers is positive, and to verify its validity, a t-test was calculated for a single sample, and the following table shows this:

Table No. (03) shows the results of the "T" test for a single sample

Sample	mean	standard deviation	hypothetical mean	T	df	sig
77	76.82	16.455	72	2.569	2.569	Significant

Table No. (03) shows that the value of the mean was 76.82, while the value of the standard deviation was 16.455. When comparing the mean of 77 with the hypothetical mean of the questionnaire, we see that the mean is greater than the value of the hypothetical mean. By applying the t-test for a single sample, it was found to be statistically significant, and this indicates that the reality of the ergonomic design of educational institutions from the point of view of middle school teachers is positive.

This result can be explained by the fact that the ergonomic design of educational institutions has become based on numerous criteria during the construction of their

internal and external spaces, in accordance with the psychological and physical needs of the educational community and the requirements of the teaching and learning process. The buildings of these institutions are designed according to standards and specifications that align with their function. The design of their classrooms takes into account adequate lighting, required ventilation, and internal and external acoustic effects, minimizing noise. Their sizes are proportionate to the number of students, and their internal corridors are wide, well-lit, and ventilated, allowing for comfortable movement for students and even teachers. The interior design also incorporates an attractive aesthetic through open spaces, green areas, and spacious courtyards capable of accommodating the number of students. Furthermore, the location of the educational institution is suitable, and the design of the exterior facade is based on environmentally friendly standards, incorporating aesthetic touches such as green spaces, the colors used to paint the walls, and a formal design that suggests the nature of the building from a distance. Despite the teachers' acknowledgment of the positive aspects of ergonomic design in educational institutions, we observe many shortcomings in its design standards. It does not live up to what is required in building and equipping these institutions materially.

The result of our study is consistent with what was found in the study by Amri (2021), which concluded that the reality of the physical environment of public schools from the point of view of teachers is average. The study by Ghidi & Achoui (2022) also concluded that the ergonomics of the school environment rises to the required level from the point of view of primary school teachers.

The results of our study differed from the study by Mahali and Dahmani (2024), which concluded that most of the primary schools studied have a deficiency and shortcomings in adopting ergonomic design standards, and do not have the appropriate physical conditions for the school environment. The study by Wanas Yasmina, which was reported on by Barakat & Bouatit (2023), also concluded that the school architecture adopted in Algerian primary schools does not respect ergonomic design standards

4.2- Second hypothesis:

It stated that there are differences in the reality of ergonomic design from the point of view of middle school teachers according to the variable of the building's location, and to verify its validity, a t-test was calculated, and the following table shows this result.

Table No. (04): the differences in the level of ergonomic design according to the building's location

The variable	n	mean	standard deviation	t	sig
Semi-urban	37	71.76	15.994	2.701	significant
Urban	40	81.50	15.643		

Table No. (04) shows that the value of "t" of 2.701 is statistically significant at the level of 0.05, which means that there are differences in the reality of ergonomic design from the point of view of middle school teachers according to the variable of the location of the institution and in favor of middle schools in urban areas.

The result of the differences in the reality of the ergonomic design of educational institutions, in favor of middle schools located in urban areas, can be explained as they are designed according to what the region and the urban fabric in which they are located require. The ergonomic design of middle schools located in major cities differs from their counterparts in semi-urban areas, as in the former they are designed according to high-quality standards that provide comfort for students, teachers and educational staff, and

this design is related to the internal and external appearance. As for the institutions located in semi-urban areas, some of the standards required for the success of the educational learning process are overlooked and neglected. Despite the existence of differences, they are minor differences.

4.3- Third hypothesis:

It stated that there are differences in the reality of ergonomic design from the point of view of middle school teachers according to the variable of the age of the building, and to verify its validity, a t-test was calculated, and the following table shows this result.

Table No. (04): the differences in the reality of ergonomic design according to the age of the building

The variable	n	mean	standard deviation	t	sig
Old	52	77.12	17.665	0.227	Not significant
Modern	25	76.20	13.916		

Table No. (04) shows that the value of “t” of 0.227 is not statistically significant at the level of 0.05, which means that there are no differences in the reality of ergonomic design from the point of view of middle school teachers according to the variable of the age of the building (old, modern).

The lack of differences in the reality of ergonomic design of educational institutions from the point of view of middle school teachers can be explained according to the variable of the nature of the institution. Teachers believe that institutions established long ago or recently have the same architectural design. Despite the recent technological and architectural development, the nature of the construction of educational institutions still maintains the nature of the old architecture, although some minor modifications have been introduced to their construction, but they have not reached what is required and internationally recognized in the ergonomic design of educational institutions.

5- Recommendations:

Based on the findings of the current study, the researchers recommend the following:

- The necessity of applying ergonomics during the design of school buildings.
- The need to consider the local environment during the engineering design of educational institutions by taking into account the nature of the community and the physical conditions.
- It is necessary to involve ergonomics specialists and architects during the design and construction of educational institutions according to modern models.
- The need to conduct more in-depth studies to uncover the most important ergonomic design requirements for educational institutions.

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