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Bioclimatic architecture and its influence on neuroarchitecture. Case study: FAU-UG, Guayaquil, Ecuador

Arquitectura bioclimática en influencia en la neuroarquitectura. Caso de Estudio: FAU-UG, Guayaquil, Ecuador

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ABSTRACT

Bioclimatic architecture focuses on the design of buildings that take advantage of the natural conditions of the environment to improve thermal, lighting, and acoustic comfort, which has a direct impact on people's well-being and cognitive comfort. However, the focus of this study is characterized by the function of bioclimatic criteria as indicators that contribute to the cognitive comfort of people with ASD and psychosensory disorders within the Faculty of Architecture and Urbanism. It should be noted that at the University of Guayaquil, 12.45% of students suffer from psychological disorders due to stress and mental exhaustion, which is why the study is justified in seeking to create spaces that promote relaxation and overall comfort. According to a sample provided by the Student Welfare Department, more than 68% of students at the Faculty of Architecture and Urbanism (FAU) experience stress, as determined by a student census, which also revealed that 5.63% have ASD and psychosensory disorders, which are attributed to their

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disability. This scientific document will address techniques for establishing comfortable spaces within the faculty's classroom modules and provide criteria based on cognitive analysis and decision-making. It concludes that the study of individuals' own faculties contributed to deriving criteria for sizing and active contact with natural spaces, which led to a 65% decrease in psychosensory disorders and a 50% increase in concentration within the classroom.

Keywords: neuroarchitecture, cognitive comfort, ASD, bioclimatic architecture

RESUMEN

La arquitectura bioclimática se enfoca en el diseño de edificaciones que aprovechan las condiciones naturales del entorno para mejorar el confort térmico, lumínico y acústico, lo que tiene un impacto directo en el bienestar y el confort cognitivo de las personas. Mas no obstante el enfoque del presente estudio se caracteriza en la función de los criterios bioclimáticos como indicadores que aporten al confort cognitivo de las personas con TEA y alteraciones psicosensoriales dentro de la Facultad de Arqiutectura y Urbanismo. Se destaca que en la Universidad de Guayaquil como tal un 12,45% responden a alteraciones psicológicas por factores de estrés y agotamiento mental por lo que el estudio se justifica al tratar de generar espacios que generen relajación y confort integral. En la Facultad de Arquitectura y Urbanismo según una muestra proporcionada por el Departamento de Bienestar Estudiantil, existe un nivel de estrés de más del 68% de los estudiantes de la FAU, determinado por un censo estudiantil el cual arrojo también como dato importante que el 5,63% tienen TEA y alteraciones psicosensoriales las cuales se atribuyen a s discapacidad. El presente documento científico abordara las técnicas para establecer espacios confortables dentro de los módulos de aulas de la Facultad y proporcionar criterios desde un análisis cognitivo y de toma de decisiones. Se concluye que el estudio de las facultades propias de los individuos aporto a derivar un criterio de dimensionamiento y contacto activo con espacios naturales que propiciaron una

disminución del 65% de alteraciones psicosensoriales y aumentaron en un 50% la concentración dentro del aula de clase.
Palabras clave: neuroarquitectura, confort cognitivo, TEA, arquitectura bioclimática

INTRODUCTION

Bioclimatic architecture and neuroarchitecture are two approaches that, although based on different principles, can complement each other to create more efficient, healthy spaces adapted to human needs. Neuroarchitecture is an interdisciplinary field that combines neuroscience, psychology, and architecture as a particular approach to designing environments that promote well-being and improve cognitive and sensory functioning (Kadıoğlu-Akbulut et al. 2023). In the context of educational spaces, neuroarchitecture can play a crucial role in creating environments that support and improve psychological recovery (Kolonin 2022).

Studies have shown that the physical environment can significantly affect a person's mood, behavior, and overall well-being. For example, spaces with natural light, a view of nature, and comfortable furniture can create a calm and supportive environment (Papanastasiou et al. 2022), while spaces with poor lighting, clutter, and inadequate ventilation can increase levels of anxiety and stress.

Neuroarchitecture can also help address specific psychological conditions by using sensory stimulation to promote relaxation and reduce symptoms of anxiety, depression, and post-traumatic stress disorder (PTSD). For example, incorporating elements such as natural light, water features, and plants can help reduce stress levels and promote a sense of calm, while the use of textures, colors, and patterns can be used to create a sensory-rich environment that engages the brain and reduces symptoms of anxiety.

In spaces, it is also important to consider the needs and preferences of individuals and their relationship with the environment (Unni et al. 2022). For example, some people may prefer a quiet and serene environment, while others may benefit from a more active and engaging space, but these spaces must be in harmony with nature.

The interaction between bioclimatic architecture and neuroarchitecture allows for the creation of spaces that are not only sustainable and efficient, but also healthy and adapted to human needs. This integration is key to the future of architectural design, where people's well-being and respect for the environment must go hand in hand.

MATERIALS AND METHODS

The study of psychological conditions within study spaces is an important field of research that focuses on understanding how the physical environment of study spaces affects patients' mental health and well-being (Erkan 2021).

Physical study spaces are designed to help people recover from injuries or illnesses that affect their physical abilities (Pico et al. 2021). However, these spaces can also have a

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significant impact on patients' psychological well-being. For example, the design of a study space can influence patients' perceptions of their progress, levels of motivation, and overall satisfaction with their treatment.

Psychological study spaces in Ecuador provide treatment focused on patient dissipation through activities in semi-open spaces, periodic testing, prescribed medication, and personalized interaction. This model has had a 46% effectiveness rate across its 42 accredited psychological study centers throughout the country (Álvarez Córdova et al. 2020).

Research in this field explores the impact of psychological study using complementary elements such as natural light, colors, sound, public spaces, green areas, and furniture to reduce stress levels and improve the overall well-being of patients. Other factors that can be explored include the design and organization of space, the degree of privacy and social interaction, and the presence of visual distractions or stressors.

Psychological conditions that can be studied within study spaces include anxiety, depression, post-traumatic stress disorder (PTSD), and adjustment disorder. These conditions, based on neuroarchitecture design standards, can have a significant impact on the recovery process of patients, as well as their overall quality of life.

Perceptions of bioclimatic architecture and neuroarchitecture

Perception is a central concept in neuroarchitecture, as the design of physical spaces directly influences how people experience space. Visual perception manifests interpretations of color, texture, shape, and lighting. The primary axis of visual perception is contrast, which is used as the tool that shapes this type of perception (Papanastasiou et al. 2022), taking into account that contrasting colors or textures can highlight certain characteristics or create a sense of depth in a space.

As a second compositional axis, the design and organization of a space influence the perception of clarity and mental dissipation by employing, for example, unobstructed lines of sight that allow for the creation of sensations such as order and control, while a more chaotic space filled with elements can create feelings of confusion and disorientation (Yarushev and Averkin 2018).

Natural perception is defined within semi-open and open spaces in relation to public spaces where natural elements such as green areas and bodies of water are distributed and integrated with furniture, creating a sense of calm and relaxation (Ajrina and Kustiwan 2019), while harder industrial materials can create a sense of tension or unease.

Sound perception is established as an articulating element within neuroarchitecture. The acoustics of a space can affect how people experience and interpret sound, and the use of soundscapes or background noise can create a specific atmosphere or mood (Karakas and Yildiz 2020).

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Spatial perception can affect social behavior. Thus, the distribution between closed, semi-open, and open spaces would encourage social interaction, while a closed space with an interior layout can create a feeling of intimacy or concentration (Salingaros 2020).

Perceptions play a fundamental role in how people experience and interpret physical spaces. By understanding how design affects perception, designers can create spaces that are not only functional and aesthetically pleasing, but also support specific moods, behaviors, and experiences (Banaei et al. 2017).

The objective of this study is to provide a comprehensive study of the patient by addressing a neuroarchitecture approach, applying considerations of sensory and spatial perception that contribute to dispersion, concentration, and socialization within spaces that respond to the senses, enhancing relaxation and the treatment process.

In conclusion, the application of neuroarchitecture in physical study spaces has the potential to greatly enhance the recovery process for people with psychological conditions (Bermudez et al. 2017). By creating environments that support well-being, promote a sense of calm, and engage the senses, neuroarchitecture can play a critical role in helping people achieve their study goals.

Towards an interrelational methodology

Traditionally, a unidirectional approach has been used, but in this case, the interrelation between two approaches turns the study into a search for information and data that can reveal the real conditions of the phenomenon; therefore, a mixed-method approach will be used. The evaluation of the current study model and its characteristics plays a circumstantial role in understanding the particular condition of individuals with ASD or psychosensory impairments, for which their current conditions will be recorded as determined in the following table:

Table1 . *Characterization of psychosensory impairments among FAU-UG students.*

Period	Faculty	Impairment	Percentage	Status
2024-2025 IIC	Architecture and Urban Planning	Psychosocial	4.26	Second enrollment
2024-2025 IIC	Architecture and Urban Planning	Stress	68.0	First - Second enrollment
2024-2025 IIC	Architecture and Urban Planning	TEA	5.63	Third enrollment
2024-2025 IIC	Architecture and Urban Planning	Psychosensory Disability	2.25	Second enrollment

Note: Data from the FAU-UG Student Welfare Department (2024)

In recent years, the number of students with disabilities has grown by 3% (data taken from the average – FAU-UG Student Welfare), which means that classrooms and teaching staff must be trained and updated to cater for a comprehensive and inclusive educational model that was not conceived at the beginning of the faculty. The following table shows the case of students with psychosensory impairments enrolled in this second semester of the current year, identifying that the dropout rate or number of enrollments resulting from repeating the course is more consistent in this type of social stratum. This background information made it possible to visualize that part of the educational structure does not generate support for disabilities, which is growing in relevance semester after semester.

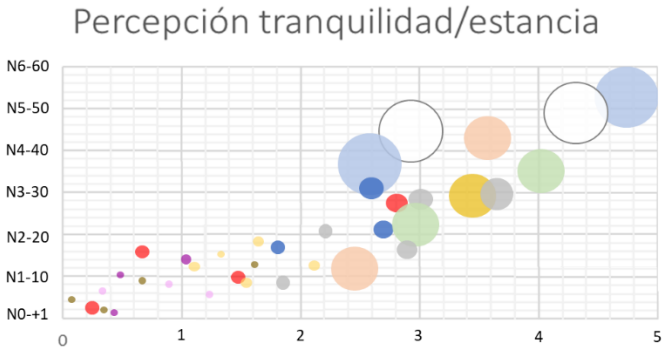
The decision-making method is used as a tool to determine individuals' preferences through their collective experience in analyzing the situation, the problem, the decision, and the potential problems encountered by each individual, generating a weighted average of results.

RESULTS

Standardized criteria

To establish the standardized criteria, the two architectural approaches studied (bioclimate and neuro) were taken into account, with color, shape, interaction with green areas, and social integration as optimal fundamentals. The scatter plot established levels of acceptance by the users surveyed (60), ranging from a level of 0 to a level of 5 in relation to color and its minimum or maximum weighting to form the dispersion of choice.

Table 1. *Scatter plot for color choice.*



Color	Percepción tranquilidad/estancia
Rojo	2
Blanco	5
Morado	1
Gris	2
Verde	4
Celeste	5
Rosa	1
Amarillo	1
Durazno	4
Caoba	1
Marrón	4
Violeta	2
Azul	2

Note: Prepared by the authors.

The colors proposed focused on the perception of the patient's emotional health and how these colors stimulate tranquility and the stay of users within a psychiatric center. The established color palette is based on current color trends in treatment spaces. According to the scatter plot, the most appropriate colors are white, blue, green, peach, and brown, as they obtained the highest acceptance score from users (60).

Table 2 . *Spatial matrix of form by structuring.*

Matriz espacial de forma			
Espacios	Forma	Estructuración	Ponderación
Área de atención usuario	Circular	Concentrica	3
	Cuadrada	Lineal	2
Dormitorios	Cuadrada	Lineal	1
	Cuadrada	Lineal con esquinas curvas	3
	Cuadrada	Con adiciones rectas	2
Aulas	Cuadrada	Lineal	2
	Cuadrada	Lineal con esquinas curvas	2
Zonas comunes	Cicular	Excentrica y combinada con forma recta	3
	Circular	Concentrica	3
	Cuadrada	Simple	1
Espacios exteriores	Circular	Simple	1
	Circular	Concentrica	3
	Cuadrada	Simple	1

Note: Prepared by the authors.

The shape choices are based on the conceptualization of shape and structure, whether the shape is maintained or whether combinations of shapes generate succession without creating voids, complex transit spaces, or spaces with no apparent exit. The framework of options is designed in accordance with existing analogous models and design guidelines for functional neuroarchitecture spaces. The weightings are established in ranges from 1 to 3, with the highest being the best selection.

Table 3. Positive and negative perceptual selection of green and social areas.

Selección perceptiva		
Denominador	Positiva	Negativa
Interacción con áreas verdes		
Integración social		

Note: Prepared by the authors.

Interaction with green areas and social integration generate a positive perception of this model integrated into buildings as part of psychological treatment.

DISCUSSION

The combination of these innovative trends is becoming a recurring pattern applied in multiple projects. A formula focused on human well-being that also has a positive impact on energy efficiency and sustainability.

The implementation of neuroarchitecture and bioclimatic design in educational spaces (classrooms) has a notable impact on employee well-being and, consequently, improved performance. For example, a study by the University of Exeter found that introducing plants into the office increased productivity by 15%, as it reduced visual and mental fatigue and improved concentration (Ghazvinian et al., 2019).

The application of bioclimatic architecture in neuroarchitecture represents a convergence between energy efficiency and human well-being. Both disciplines, although with different approaches, share common goals: to create spaces that improve people's quality of life while respecting the environment. The relationship between bioclimatic architecture and neuroarchitecture allows for the creation of spaces that are not only energy efficient and environmentally friendly, but also promote the emotional and cognitive well-being of students.

REFERENCES

Awasthi, A., Omrani, H., & Gerber, P. (2018). Investigating ideal-solution based Brandel, N., Schwarz, B. B., Cedar, T., Baker, M. J., Bietti, L. M., Pallarès, G., & Détienne, F. (2024). Dialogue on ethics and ethics of dialogue: an exploratory study. Volume 39, Issue 3, Pages 2619 - 2654. https://doi.org/10.1007/s10212-024-00856-z

Choe, Y., & Kim, N. (2024). From the classroom to the Living Lab for developing competencies in tourism higher education. Journal of Hospitality, Leisure, Sport and Tourism Education, 35, 100511. https://doi.org/10.1016/j.jhlste.2024.100511

Colorado-Pastor, B. A., Fois Lugo, M., Vazquez, M. L., & Hechavarría Hernández, J. R. (2020). Proposal of a technological ergonomic model for people with disabilities in the public transport system in Guayaquil. In Advances in Intelligent Systems and Computing (Vol. 972). https://doi.org/10.1007/978-3-030-19135-1_81

Estima, A., & Carvalho, A. C. (2024). Strategies for Inclusive Learning: A Marketing Faculty's Journey with Students with Intellectual and Developmental Disabilities. International Conference on Higher Education Advances, 327–334. https://doi.org/10.4995/HEAd24.2024.17100

González, R. S., & Cruz, M. L. (2022). Participation of people with disabilities in the educational context: conceptual and methodological proposals. Volume 20, Issue 1, Pages 173 - 196, 20(1), 173–196. https://doi.org/10.14516/FDE.918

Guaicha, J. A. M., Zamora, A. A. M., & Morloy, L. I. Z. (2024). Learning Models in the Transition Towards Complexity as a Challenge to Simplicity. Sophia (Ecuador), 2024(36), 69–112. https://doi.org/10.17163/soph.n36.2024.02

Hosseini, M., & Bousbaci, R. (2024). Quebec Educational Program, Pedagogical Approaches, and Design of Educational Spaces. Journal of Architectural Engineering, 30(4), 05024008. https://doi.org/10.1061/JAEIED.AEENG-1787

Jácome, K., Almache, D., Pástor, D., Ávila, D., & Arcos-Medina, G. (2025). Custom Learning: An Educational Content Recommendation System Based on Learning Styles. Volume 18, Issue 1, Pages 93 - 111, 18(1), 93–111. https://doi.org/10.18848/1835-9795/CGP/v18i01/93-111

Lam, R. (2024). Integrating e-portfolios into L2 classrooms: Education for future. In Integrating e-Portfolios into L2 Classrooms: Education for Future. Channel View Publications. https://doi.org/10.21832/LAM5805

Luck, R. (2022). Access and Mobility in Milton Keynes: An Inclusive Design History where Urban Planning Ideals and Design Intent Meet Disability Politics. Disena, 21, 6. https://doi.org/10.7764/disena.21.Article.6

Mathiasen, H., & Schrum, L. (2010). New technologies, learning systems, and communication: Reducing complexity in the educational system. In New Science of Learning: Cognition, Computers and Collaboration in Education (pp. 385–403). Springer New York. https://doi.org/10.1007/978-1-4419-5716-0_19

Moreira, G. M. M., & Gaibor, D. A. C. (2020). Students with special educational needs. Obstacle or challenge in inclusive university education. University and Society, 12(4), 257–264.

Silva Duarte, D. H., Teixeira Gonçalves, F. L., Silva Duarte, D. H., & Teixeira Gonçalves, F. L. (2022). Urban climate adaptation: an interdisciplinary research experience empowering architecture and urbanism education. Revista de Arquitectura (Bogotá), 24(2), 116–125. https://doi.org/10.14718/REVARQ.2022.24.4380

Spiegel, J. B., Ortiz Choukroun, B., Campaña, A., Boydell, K. M., Breilh, J., & Yassi, A. (2019). Social transformation, collective health and community-based arts: 'Buen Vivir' and Ecuador's social circus programme. Global Public Health, 14(6), 899–922. https://doi.org/10.1080/17441692.2018.1504102

Urzúa, G. A. E. (2024). Philosophical foundations for a pedagogy of culture. Sophia (Ecuador), 2024(37), 191–219. https://doi.org/10.17163/soph.n37.2024.06

Vila-Merino, E. S., Rascón-Gómez, T., & Calderón-Almendros, I. (2024). Disability, stigma, and suffering in schools. Emerging narratives for the right to inclusive

education. Educacion XXI, 27(1), 353–371. https://doi.org/10.5944/educxx1.36753

Vivas, G. P. M., Chacón, J. W. B., & Peña, H. C. (2015). Development of information skills in college: Approaches, models and intervention strategies. Volume 29, Issue 65, Pages 39 - 72, 29(65), 39–72. https://doi.org/10.1016/j.ibbai.2016.02.014

Yusof, M. M. M., Shaafi, N. F., & Zaini, N. A. F. (2024). Planetarium pedagogy and technical learning experience: an investigation from instructional perspectives. International Journal of Evaluation and Research in Education, 13(3), 1931–1944. https://doi.org/10.11591/ijere.v13i3.25018