

Experimental materials laboratory: construction of a Pizza Oven in the Architecture and Urbanism graduate

Laboratório experimental de materiais: construção do forno de pizza na graduação em Arquitetura e Urbanismo

Laboratorio de materiales experimentales: construcción del horno de pizza em la carrera de Arquitectura y Urbanismo

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Abstract

This article is an experience report in the discipline of Built Environment Technology in the Architecture and Urban Planning course at the State University of Mato Grosso – UNEMAT. The course in question is offered in a differentiated teaching modality, a novelty in the context of Architecture and Urban Planning in Mato Grosso. The activity is a pedagogical proposal in the training of Architects and Urbanists, for the planning and execution of a pizza oven as an experimental laboratory for the discipline, with practice in civil construction, construction sites and other ways of creating space from vernacular techniques. This activity enabled the students to engage with the discipline, contributing to critical thinking about Built Environment Technology in the context of Architecture and Urban Planning.

Keywords: Pizza Oven; Experimental Architecture Laboratory; Built Environment Technology; Civil Construction; Construction Site.

Resumo

Este artigo trata de um relato de experiência na disciplina de Tecnologia do Ambiente Construído, no curso de Arquitetura e Urbanismo, na Universidade do Estado de Mato Grosso (Unemat). O curso em questão é ofertado em uma modalidade de ensino diferenciada, novidade no contexto da Arquitetura e Urbanismo em Mato Grosso. A atividade trata de uma proposta pedagógica na formação de arquitetos e urbanistas para o planejamento e a execução de um forno de pizza como laboratório experimental da disciplina, com prática na construção civil, canteiros de obras e outros modos de fazer o espaço a partir de técnicas vernaculares. Essa atividade possibilitou o engajamento dos alunos com a disciplina, contribuindo com a criticidade ao pensar a Tecnologia do Ambiente Construído no âmbito da Arquitetura e Urbanismo.

Palavras-chave: Forno de pizza; Laboratório Experimental de Arquitetura; Tecnologia do Ambiente Construído; Construção civil; Canteiro de obras.

Resumen

Este artículo es un relato de experiencia en la disciplina Tecnología del Ambiente Construido en el curso de Arquitectura y Urbanismo de la Universidad Estadual de Mato Grosso – UNEMAT. El curso en cuestión se ofrece en una modalidad de enseñanza diferente, nueva en el contexto de la Arquitectura y Urbanismo en Mato Grosso. La actividad es una propuesta pedagógica en la formación de Arquitectos y Urbanistas, para la planificación y ejecución de un horno de pizza como laboratorio experimental de la disciplina, con práctica en construcción civil, obras de construcción y otras formas de crear espacio utilizando técnicas vernáculas. Esta actividad permitió a los estudiantes involucrarse con el tema, contribuyendo al pensamiento crítico sobre la tecnología del entorno construido en el ámbito de la Arquitectura y el Urbanismo.

Palabras clave: Horno de Pizza; Laboratorio de Arquitectura Experimental; Tecnología de Entorno Construido. Construcción Civil; Sitio de Construcción.



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INTRODUCTION/PRESENTATION

Where does Built Environment Technology reside within Brazilian architecture? In buildings considered of high financial standard? Or does it emerge from popular and ancestral constructions? For architects and urban planners, is reflecting on Built Environment Technology essential for achieving good results in architectural production? Or is Built Environment Technology merely a stumbling block along the path of Architecture and Urban Planning?

Good architecture is based on its aesthetic outcome, instrumental adequacy, and constructive rationality. In other words, there is a meaningful framework that defines what constitutes good architecture. As Silva (1998) points out, for something to be considered architecture, it must be built. Otherwise, it is merely an educational or conceptual exercise. To create architecture that demonstrates strong aesthetic results, instrumental adequacy, and constructive rationality, it is necessary to consider the best practices of Built Environment Technology.

This paper presents and describes an activity developed within the discipline of Built Environment Technology, offered in the 4th semester of the Architecture and Urban Planning program at the State University of Mato Grosso, in a differentiated teaching modality, in a single cohort located in the city of Colíder – Mato Grosso. Through dialogue with the class, the idea arose to propose a practical-didactic activity aimed at strengthening and establishing a connection between the theoretical and practical knowledge of Built Environment Technology.

This activity sought to consolidate the knowledge acquired in alignment with the course syllabus. It enabled a pedagogical practice through an experimental laboratory experience involving construction site dynamics and the building of a pizza oven for use by the entire academic, technical, and teaching community of the Vale do Teles Pires University Campus in Colíder – Mato Grosso.

Possible Pedagogy in Undergraduate Architecture and Urban Planning

When reflecting on Architecture, it is important to address both its etymology and its conceptual foundation. The project always occupies the position of a means, never an end. Only certain aspects of the future construction can be evaluated through the project — such as form, dimensions, circulation schemes, sunlight conditions, natural and artificial lighting, material choices, construction techniques, and finishing. In other words, architectural value lies both in the design and in the built work, not solely in the design itself. Within certain limits, this makes it possible to evaluate a project's potential as a proposal (Silva, 1998).



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According to Silva (1998), the design process depends on appropriate technical and scientific knowledge so that the proposed solutions do not present inconsistencies. Therefore, contextual constraints — such as site characteristics, specific requirements, legislation, and sociocultural context — are essential for a well-developed proposal, always associated with sound solutions in Built Environment Technology.

It is also necessary that decisions be well established during the preliminary study phase, with a strong architectural concept so that, by the time of the schematic design, choices regarding materials and construction techniques remain coherent with local conditions, as well as with aspects of sunlight, form, and acoustics.

In Architecture and Urban Planning education, it is crucial that teaching be aligned with research and, by extension, with a pedagogy engaged in social causes. The architectural and urban design process must correspond to the realities of civil construction, which can only be achieved through strong engagement between professors and students in laboratory and field practice.

Within academia, teaching, research, and outreach should be grounded in an engaged pedagogy. Such pedagogy, based on the students' reality and the local context in which the undergraduate program operates, must distance itself from the "banking" concept of education, and instead be designed and implemented to involve students actively within their context.

Multiculturalism compels educators to recognize the narrow boundaries that have historically shaped the way knowledge is shared in the classroom. It forces all of us to acknowledge our complicity in accepting and perpetuating various forms of bias and prejudice. Students are eager to dismantle the barriers to knowledge. They are willing to surrender to the wonder of learning and relearning new ways of knowing that go against the current. When we, as educators, allow our pedagogy to be radically transformed by recognizing the multicultural nature of the world, we can offer students the education they desire and deserve. We can teach in a way that transforms consciousness, creating an atmosphere of free expression, the essence of a truly liberating liberal arts education (Hooks, 2017, p. 63).

As Hooks (2017) explains, students may have lost hope, but they still insist that education must be liberating, something that can heal their uninformed and perhaps ignorant spirit. Engaged pedagogy values the student's expression. In it, the student is not the only one invited to share in this place of growth and learning: the teacher must train themselves to be open in the classroom, fully present in mind, body, and spirit, while embracing the practice of continual self-renewal.



Authentic education, to repeat, is not carried out from “A” to “B,” or from “A” over “B,” but rather from “A” with “B,” mediated by the world. A world that impresses itself upon both, generating views or perspectives about it, visions filled with desires, doubts, hopes, or despair, which form the basis for the educational content. One of the mistakes of a naïve conception of humanism is that, in the eagerness to embody an ideal model of the “good man,” it forgets the concrete, existential, present situation of real human beings (Freire, 1987, p. 97).

The humanization of dehumanization is a constant pursuit for those seeking liberation through free work and de-alienation, not becoming oppressors but rather restorers of humanity. When thinking about classroom dynamics, one must be careful not to reproduce the banking model of education, nor to suppress the creative power of students by encouraging naivety instead of criticality. Embracing a pedagogy of autonomy fosters students’ critical thinking and resists the interests of oppressors, which contribute nothing to the pedagogical process (Freire, 1987).

The proposal of the experimental laboratory through the construction of a pizza oven aims to contribute pedagogically to students’ understanding and practice in studying building materials, elements, and construction systems including binders, aggregates, mortars, masonry components, material applications, safety systems, and critical reflection on the morphology of the built space.

Knowledge in this process is cooperatively produced through the participation of professors, students, and technicians. Each, with their own life experiences and contexts, contributes responsibly and meaningfully to overcoming shared challenges by exchanging perspectives. The systemic relationships considered essential include, but are not limited to, those related to the field of construction techniques. They should also open space to uncover what everyday life conceals, what social inequality naturalizes, and what traditional education structures reinforce as separate (Ronconi, 2005, p. 145).

The use of the experimental laboratory emerged as a demand from students amid discussions on the need to strengthen practical construction experience in the Architecture and Urban Planning curriculum. Although this may be distant from some realities, it is essential that educators incorporate on-site practice as a means of connecting theory and practice within the realm of civil construction.

The practical component begins in the classroom with technical and theoretical approaches, including initial discussions and technical research for the activity’s development. After this stage, the first ideas are collaboratively produced with the students, followed by the design process for building the pizza oven. This activity



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was proposed to students in a nontraditional format, and from the very beginning, they showed great interest and engagement in the hands-on learning experience that the project provided.

Methodological Discussion

This is an account of an experience in the Built Environment Technology course, in the Architecture and Urbanism undergraduate program, with the purpose of developing a pizza oven as an experimental laboratory practice. The course is offered in the second year – 4th semester. The work in question is based on qualitative research.

The experience report contributes to the construction of knowledge. As stated by Almeida, Flores, and Mussi (2021), the experience report, in the context of academia, allows a close experience, with appreciation through academic-scientific effort, by means of critical-reflective application supported by theoretical and methodological foundations. It also contributes to the dialogue, mainly between teaching and research, but also to teaching, research, and extension in higher education institutions.

In the course in question, each semester has a thematic axis that delimits the subjects offered. In the 1st year, it is called "Perception and Representation," divided into the 1st phase as "Introduction to Architecture and Urbanism," and the 2nd phase as "Minimal Project." In the 2nd year, it is called "Inhabiting the City," with the 3rd phase as "Housing Unit" and the 4th phase as "Collective Housing." In the 3rd year, it is called "City: Public and Private Space," with the 5th phase as "Open Spaces," and the 6th phase as "Multifunctional Nuclei." In the 4th year, it is called "Structuring the Regional Space," with the 7th phase as "Intra-Urban Scale" and the 8th phase as "Urban Networks, Cities, and Regions." To conclude the course, the 5th year is called "Professional Practice," with the 9th and 10th phases also as "Professional Practice."

The stages of the activities were divided into planning and execution. In the planning stage, feasibility, schematic design, material survey, and strategies to be requested from the university were carried out. All planning was conducted in the classroom, with the collective contribution of all students participating in the discipline, as well as the professor. After classroom planning, the date of the activity was coordinated with the campus, along with the request for the necessary supplies for the activities.

The basic and complementary bibliographic references of the discipline provided the technical and bibliographic support for the implementation of the experimental laboratory, with lectures, presentations, and open discussion. The choice of materials adopted in the activity was made according to local conditions, feasibility, and availability, so that in the practical moment, the decisions were appropriate.



For the evaluation of the activity, criteria were established based on student engagement, good practices in civil construction, and an experience report carried out after the completion of the activity. Regarding engagement, interaction, performance in planning and execution of the pizza oven, as well as the collective relationship inseparable from any construction site, were evaluated. Regarding good practices in civil construction, the execution of materials was evaluated according to conventions and scientific principles, to ensure durability and avoid pathologies resulting from poor execution. The last evaluation criterion, the experience report, was used to measure the learning acquired by the students through the activity.

The Experimental Laboratory and the Pizza Oven

Practice within the Architecture and Urbanism program is extensive. When analyzing the entire curriculum, one can observe the consistent practical credit load of the courses Architectural Design, Urban Design, Interior Design, and Landscape Design. However, such practice is mainly related to the act of designing an essential exercise in the professional life of architects and urban planners but it is not sufficient when considering the actual construction of built space.

Although the Architecture and Urbanism program has its largest workload in design courses, it is important that the proposals outlined in the political and pedagogical project of these programs clearly include practice in civil construction; that is, courses focused on construction techniques, building systems, and construction sites in order to connect theory with effective construction practice. As defined by Resolution CNE/CS No. 1 of July 11, 2025, the Architecture and Urbanism and Landscape Architecture programs must meet the following requirement: "IV the sciences of materials: addressing socio-environmental impacts and the life cycles of materials applied to Architecture, Urbanism, and Landscape Architecture." (BRAZIL, 2025, Art. 5, IV).

The Architecture and Urbanism program, offered in a single cohort and under a differentiated teaching modality at the State University of Mato Grosso, includes in its curriculum the discipline Built Environment Technology, which deals with materials, construction processes, and building sites. The course carries four credits, divided into two theoretical, one practical, and one laboratory activity, totaling 60 hours.

At this university, the differentiated modality follows a special pedagogical methodology and practice, offered in the form of modules or stages, with a specific academic calendar and the option of a blended learning system (which is not the case for the Architecture and Urbanism program, whose entire course load is offered in person) (UNEMAT, 2005).



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The pizza oven activity was proposed to the students by the professor with the aim of fostering understanding and increasing their interest. From the outset, the students' enthusiasm was evident perhaps due to the rare opportunity for more direct contact with the practice of civil construction and experimental laboratory work.

It is at this point that the (re)union of art and technique becomes necessary, even during the education of the architect and urban planner. This can be achieved through practical exercises in experimental construction sites, allowing the student/designer to make the best decisions in order to merge beauty with rationality, while considering the constraints that the physical environment may impose on creativity. Alternatively, one may also reflect on how creativity can shape the available physical resources in an innovative way to achieve the envisioned result (Bessa and Librelotto, 2021, p. 01).

At the first stage of the activity, the initial technical research was presented, followed by the development of the project with the first conceptual ideas. The discussions were extensive, including a guided visit to the location chosen and authorized by the Campus for the activity, which allowed for greater contextualization of the site conditions for installing the pizza oven. In this sense, the pizza oven project was developed by the 36 students and the professor of the discipline in question. Throughout the activity, the professor promoted a pedagogy of autonomy by enabling critical discussions of the knowledge acquired in the discipline, and also throughout the entire course in a transversal manner, aiming for better strategies, always attentive to good practices in civil construction and occupational safety in the project's conception and in the planning of the activity. In these pedagogical actions, the reality of the students, the course, and the city are taken into account to bring the activity closer to the students' context and to foster greater engagement and improved outcomes. After planning the activity, with all materials already acquired and the base for the oven installation prepared by the Campus students, the date for carrying out the activity was set for the two Saturdays assigned to the course's workload. On the first Saturday, the activity began with the presence of all students, something unusual nowadays, considering students' lack of motivation regarding university education.





Figure 1: Base for pizza oven
Source: personal archive, 2023.

The planning phase began with the design of the oven base. Since it is built with clay, it cannot have direct contact with the ground. Furthermore, the chosen location does not have protection against rain, which required a resistant base that would prevent any exposure of the oven to moisture by capillarity resulting from rainfall. For the base, three concrete pipes and a reinforced concrete cover from a deactivated well that was no longer in use were employed, both capable of supporting the weight and heat produced during the oven's operation.



Figure 2: Mortar for brick laying.
Source: Elaborated by the author, 2023.

At the beginning of the production process, as an experimental laboratory activity, one measure of red soil was mixed with one measure of clay, and the use of a hoe was initially demonstrated so that they could observe the impossibility of mixing with such a tool. The only feasible method identified by the students for mixing the red soil, clay, and water was “kneading” the material using their feet.

By kneading the material with their feet, the students were able to observe its texture, the cohesion present, and also the ideal point for use, since both a



mixture that is too liquid and one that is too dry make the plasticity and cohesion of the material unworkable.



Figure 3: Marking and first rows of bricks.

Source: Elaborated by the author, 2023.

Before laying the bricks, the students were shown how to create the guide in order to obtain a perfect circumference. Due to concerns regarding the wind, the position of the oven opening was defined so that it would be faced opposite to the wind direction, thus preventing the wind from interfering unfavorably during the oven's use. A flat strip of wood, with the dimension of the predetermined oven radius, was fixed using a screw and a hinge, allowing for a full 360° circular movement. With chalk at the tip of the strip, the circular motion was performed to mark the oven's position on the base.

To begin laying the bricks, a 3-centimeter layer of mortar was applied over the entire base, ensuring greater thermal inertia of the temperature on the reinforced concrete base. Next, the laying of the first "course" of bricks begins, already defining the open space required for its use.



Figure 4: Brick laying.

Source: Elaborated by the author, 2023.

At this stage, the laying of the bricks is carried out by forming a self-supporting vaulted structure. This technology has been used since the Mesopotamians, Egyptians, and Greeks. Such a vault is built by laying the bricks according to the



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inclination indicated by the wooden guide, using the mortar (soil, clay, and water) and the interlocked bricks. At this point, the students noticed the efficiency of using vaults in self-supporting structures, as well as their rigidity and effectiveness.

It is a meticulous process, hand to hand, brick by brick, building with firmness and patience. Teamwork is reinforced, with a production line to prepare the mortar, handle it, and lay the bricks, encouraging critical discussion related to construction workers.



Figure 5: Final rows of bricks and completion.

Source: Elaborated by the author, 2023.

Now, with the work already well underway, the final “courses” of bricks are placed with the purpose of closing the vault, adopting the curved arch system to favor heat retention and preserve the temperature inside the chamber. To solve the smoke duct issue, a prefabricated ceramic flue was installed, ensuring the release of gases without contaminating the food that will be baked in the oven.

The students engaged fully in the entire activity; in a transversal manner, they formed teams and promoted highly important discussions for their education in Architecture and Urbanism, in addition to putting into practice knowledge acquired in various disciplines. The vaults, extensively studied in the course Aesthetics and History of Architecture and specifically in the discipline of Brazilian History, were related to dwellings built with raw clay, contributing to the integration of theory and practice. The course Technology of the Built Environment combined previously acquired knowledge from other subjects with the science of construction materials, elements, and building systems, with binders, mortar, masonry elements, ceramic installations, and finishes, integrating itself with the context of constructive vernacularity.

Fortunately, the teaching model of the Architecture and Urbanism program at UNEMAT in Colíder establishes the decentralization of the architect's and urban planner's training in relation to medium and large urban centers. However, the experimental construction site does not, mistakenly, become an articulating point within the disciplinary structure, even though it should be a relevant element to integrate the student with the social demands of the region.



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Figure 5: Completion of activity
Source: Elaborated by the author, 2023

FINAL CONSIDERATIONS

The experimental laboratory should be an essential subject for the education of architects and urban planners, serving as a space for the practical application of exercises that combine teaching, research, and extension, with a focus on the technology of the built environment and civil construction in general.

Throughout the entire activity, it was possible to notice the students' enthusiasm in practicing within the experimental laboratory, perhaps due to the lack of such practice in the academic field of Architecture and Urbanism, the students' desire for hands-on experience in civil construction, and/or the discovery of the possibilities for discussion during the activity in question. It is important to develop proposals for construction sites and experimental laboratories within undergraduate programs.

Regarding this matter, which deserves attention, it is the responsibility of professors who are architects and urban planners to promote construction sites and experimental laboratories and to define how the inclusion of these spaces will take place within our Architecture and Urbanism programs, seeking practices that, in a transversal manner, integrate students with the social demands of the field.



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