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UNIVERSAL DESIGN AND ACTIVE METHODOLOGIES: A PRACTICE IN POSTGRADUATE STUDIES

DESENHO UNIVERSAL E METODOLOGIAS ATIVAS: UMA PRÁTICA NA PÓS-GRADUAÇÃO

DISEÑO UNIVERSAL Y METODOLOGÍAS ACTIVAS: UNA PRÁCTICA EN LOS ESTUDIOS DE POSGRADO

Figure 0. Tactile maps. Source: Prepared by the authors, 2024.

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RESUMO

A disciplina optativa DAU 848 "Estratégias de ensino em Arquitetura e Urbanismo" do Programa de Pós Graduação em Arquitetura, Urbanismo e Paisagismo (PPGAUP) Universidade Federal de Santa Maria (UFSM) explora a reflexão sobre o ensino nos Cursos de Arquitetura e Urbanismo. Em conjunto com o projeto de pesquisa de pós-doutorado "Fabricação digital aplicada ao Desenho Universal e Ergonomia" do PPGAUP, a disciplina abordou no semestre 2023.2 as temáticas de Design Universal (DU) e prototipagem. Com foco nas Metodologias Ativas que incentivam a participação ativa no processo de aprendizagem, o produto final da disciplina consistia no desenvolvimento de um exercício relâmpago voltado para alunos de graduação e em conformidade com as temáticas do semestre. O objetivo deste artigo é apresentar os exercícios finais a partir do procedimento metodológico da disciplina dividido em três etapas: 1) Bases do ensino nos Cursos de Arquitetura e Urbanismo; 2) Ensino de DU; e 3) Desenho e aplicação de exercícios. Como resultado, quatro equipes desenvolveram quatro exercícios abordando mobiliário, gamificação, mapa tátil e sinalética, com discussões sobre o uso da prototipagem e aperfeiçoamentos para futura aplicação na graduação.

Palavras-chave: design universal, acessibilidade, arquitetura, ensino, metodologias ativas.

RESUMEN

La asignatura optativa DAU 848 "Estrategias de Enseñanza en Arquitectura y Urbanismo" del Programa de Posgrado en Arquitectura, Urbanismo y Paisajismo (PPGAUP) de la Universidad Federal de Santa María (UFSM) explora la reflexión sobre la enseñanza en las Carreras de Arquitectura y Urbanismo. En conjunto con el proyecto de investigación posdoctoral "Fabricación digital aplicada al Diseño Universal y Ergonomía" del PPGAUP, el curso abarcó las temáticas de Diseño Universal (UD) y creación de prototipos en el semestre 2023.2. Centrándose en Metodologías Activas que fomentan la participación activa en el proceso de aprendizaje, el producto final del curso consistió en el desarrollo de un ejercicio rápido dirigido a estudiantes de pregrado y de acuerdo con las temáticas del semestre. El objetivo de este artículo es presentar los ejercicios finales basados en el procedimiento metodológico de la disciplina divididos en tres etapas: 1) Bases de la enseñanza en las Carreras de Arquitectura y Urbanismo; 2) Docencia UD; y 3) Diseño y aplicación de ejercicios. Como resultado, cuatro equipos desarrollaron cuatro ejercicios que abarcaron mobiliario, gamificación, mapas táctiles y señalización, con discusiones sobre el uso de prototipos y mejoras para futuras aplicaciones en cursos de pregrado.

Palabras clave: diseño universal, accesibilidad, arquitectura, enseñanza, metodologías activas.

ABSTRACT

The optional course DAU 848, offered by the Postgraduate Program in Architecture, Urbanism, and Landscape Architecture (PPGAUP) at the Federal University of Santa Maria (UFSM), focuses on teaching methodologies in Architecture and Urbanism Courses. In collaboration with the postdoctoral research project "Digital Fabrication Applied to Universal Design and Ergonomics" within PPGAUP, the course explored topics of Universal Design (UD) and prototyping during the second semester of 2023. Emphasizing Active Methodologies that promote student engagement in the learning process, the course culminated in the development of a quick practical exercise designed for undergraduate students and aligned with the semester's topics. This article aims to present the final exercises, structured around the course's methodological framework, which is divided into three stages: (1) Foundations of teaching in Architecture and Urbanism Courses; (2) Teaching Universal Design; and (3) Design and application of exercises. As a result, four teams developed four exercises focused on furniture design, gamification, tactile maps, and signage. These exercises included discussions on the use of prototyping and suggestions for improvements to facilitate future implementation in undergraduate courses.

Keywords: universal design, accessibility, architecture, teaching, active teaching-learning methodologies.

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INTRODUCTION

When preparing future professors, especially in graduate programs, practicing and stimulating critical reflection on teaching methods in undergraduate Architecture and Urbanism courses is needed to generate debate and establish new means of learning. Encouraging students' autonomy and understanding of the processes involved in an architectural project (Freire, 2014; Lawson, 2011), together with practical and experience-based learning (Schön, 2009), helps prepare students to become agents of their own learning. The dialog between reflection and action and active participation in the learning process is based on active methodologies to promote multiple skills and the student's participatory and collaborative attitude (Hoffmann et al., 2020). By introducing a new classroom dynamic and enabling students to have practical experiences, academic education is enriched for those who choose to teach and those who decide to follow other professional lines.

In this context, the elective course, DAU 848 - "Teaching Strategies in Architecture and Urbanism," from the Postgraduate Program in Architecture, Urbanism, and Landscaping (PPGAUP) of the Federal University of Santa Maria (UFSM), seeks to encourage a critical view of current teaching methods and stimulate the creativity of Architecture and Urbanism students, emphasizing the relationship between teaching, designing, and learning by doing. By addressing topics such as project processes and conceptual strategies and stimulating creativity, the reflection on postgraduate project teaching contributes to more maturely and consciously preparing new professors concerning their role in society and their work as educators. Conscientious professors train equally committed students and architects, which allows them to create and develop more humane and sustainable projects. This area has been part of the PPGAUP curriculum since 2018, with different focuses. In the first half of 2023, the topics addressed were Universal Design (UD) and Prototyping.

The choice of these topics is directly related to the postdoctoral research project at PPGAUP, "Digital Manufacturing Applied to Universal Design and Ergonomics." This project investigates the use of prototyping technologies in producing teaching materials that help students learn about Ergonomics and UD. Thus, integrating research and the corresponding discipline allowed using these technologies as didactic tools, establishing links between the creative process and teaching these topics in postgraduate and undergraduate studies. In addition, UD became mandatory content in Architecture and Engineering courses with Resolution No. 1 of March 26th, 2021 (Brazil, 2021).

It should be noted that the professional training of ten students in the first semester of 2023 was multidisciplinary. Eight were from the Architecture and Urbanism course, one was from the Industrial Design course, and one was from the Civil Engineering course. PPGAUP has included professors from different areas to stimulate knowledge exchange

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and attract students interested in multidisciplinary research. Focusing on interdisciplinarity and UD, it was defined that Active Teaching-Learning Methodologies (ATLM), associated with the area's final exercise, would be used to create a product. This approach differed from previous editions, where the focus had been on Architectural Design. It is also noteworthy that the subject provided a rich knowledge exchange among students about the different teaching approaches in different courses.

Therefore, this work aims to present the activities of PPGAUP's "Teaching Strategies in Architecture and Urbanism" course, focusing on the final exercise, which consisted of a lightning exercise on UD designed for application in undergraduate classes.

THEORETICAL FRAMEWORK

Universal Design (UD) is the design of products and spaces that can be used by as many users as possible, respecting human diversity and promoting inclusion in daily activities (Mace et al., 1998). In the context of buildings and the role of architects who design them, UD seeks to ensure that built spaces are safe and accommodate different users, eliminating barriers that hinder their use (Goldsmith, 2007). However, it is essential to differentiate the terms "UD" and "accessibility," which can be confused in their application. While accessibility or accessible design seeks to establish minimum conditions to meet a specific range of individuals with mobility difficulties or other restrictions, UD adopts a broader approach to include all users, regardless of their restrictions (Dorneles, 2014).

UD teaching in Architecture and Urbanism courses and other higher education degrees is essential for preparing professionals who are capable of developing accessible and inclusive products, spaces, and buildings. In this vein, the Ministry of Education (MEC) standardized CNE/CES Nº 948/2019 (Brazil, 2019), issued by the National Council of Education (CNE), which made universal design teaching mandatory as of 2021, as part of the core curricula of Higher Education Institutions (HEIs).

Teaching methodologies for UD and Accessibility have already been addressed in the works of Christophersen (2002), Bernardi (2007), Baptista (2013), Dorneles (2014), and Cambiaghi (2017), in addition to Gronostajska and Berbesz (2020). Christophersen (2002) divides these methodologies into theory, user engagement, and evaluation. The theory is the initial critical approach to UD. User engagement involves the participation of people with disabilities in lectures, seminars, or interviews. Finally, the evaluation refers to analyzing and verifying methodologies for developing appropriate products and spaces. Bernardi (2007) proposes using tactile maps as models for reading projects, which would allow the user to be engaged in the teaching process and

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adopt new forms of communication. Baptista (2013) uses methodologies such as awareness, experience, accompanied tours, identification of UD principles, international classification of functionality, ergonomic analysis, and an accessibility master plan. Dorneles (2014) works with strategies involving awareness, understanding of users' needs, transmitting technical knowledge, action, project assessment, and self-assessment. Cambiaghi (2017) adopts methods such as observation and sensitization, post-occupancy evaluation (POE), lectures, seminars, debates, and solution proposals. Finally, Gronostajska and Berbesz (2020) state that UD teaching must contemplate three dimensions: theoretical, empirical, and phenomenological.

Active Teaching-Learning Methodologies (ATLM) focus on encouraging dialog and students' autonomy as reflective and critical subjects. The goal is to make them active participants in the learning process, maximizing their understanding of the content and its applications. Therefore, these methodologies are aligned with the approach of Schön (2009), which emphasizes the role of the student as the primary agent of learning itself. This allows applying both a single approach and a set of methodologies so that competencies and skills are directly or indirectly related to the content studied. Hybrid approaches encourage the development of multiple skills and seek to transform classes into more impactful student experiences, promoting critical thinking, autonomy, and coexistence with diversity (Hoffmann et al., 2020). In addition, new technologies should be integrated and explored, interacting with the digital culture of new generations and encouraging students' active participation in the learning environment.

In architecture, design, and engineering teaching, the methodologies that stand out the most include project-based and problem-based learning, teamwork or team learning, cooperative or collaborative learning, educational games, and the inverted classroom (Hoffmann et al., 2020). These strategies generally focus on student learning, stimulating reflection on a problem, and proposing solutions, individually or in a group (Maziero, 2018).

METHODOLOGY

The discipline was structured into three stages: 1) Teaching guidelines in Architecture and Urbanism courses, 2) UD teaching, and 3) Design and application of exercises. In the first stage, which was dedicated to teaching guidelines in Architecture and Urbanism courses, weekly exhibition classes were held between April and May, accompanied by debates on structuring teaching in the area. These discussions explored conceptual issues such as the curriculum and the triad of research, teaching, and outreach. The students were encouraged to read specific bibliographies for each class beforehand so that they could present their reflections and relate them to experiences from their academic

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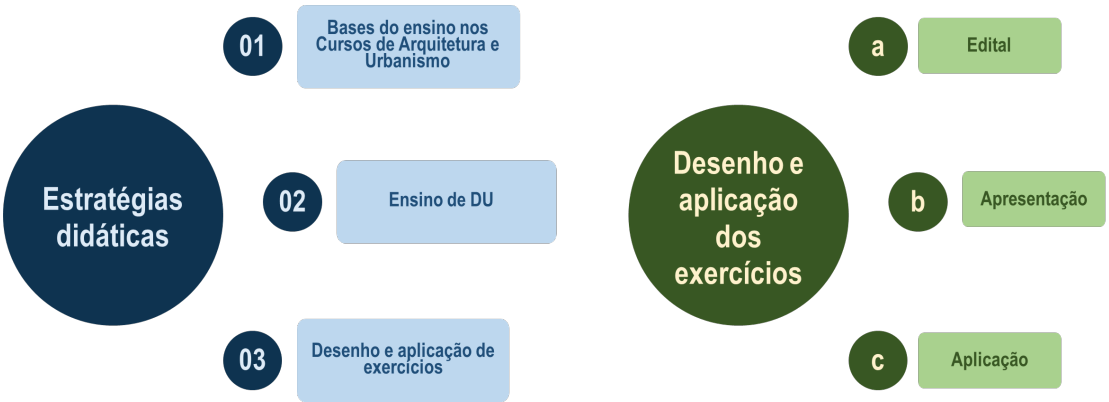

Figure 1. Methodological process. Source: Prepared by the authors, 2024

background. The references used were ***Pedagogy of Autonomy*** (Freire, 2014), ***Educating the Reflective Practitioner: Toward a New Design for Teaching and Learning***(Schön, 2009), ***How Designers Think***(Lawson, 2011), and ***From Diagram to Experiences, Towards an Architecture of Action*** (Montaner, 2017).

After discussing the forms of teaching in Architecture and Urbanism courses, the second stage, which began at the end of May, specifically addressed teaching UD. UD's main concepts and principles, i.e., differentiation regarding accessibility, current legislation, and the types of architectural barriers, were presented. The main bibliographic reference for this stage was the doctoral thesis, ***Universal Design Teaching Strategies in Urban Design Classes*** (Dorneles, 2014).

Finally, in the third stage, held between June and July, the students, organized in teams of two to three, were challenged to develop a lightning exercise on accessibility, which would be tested among classmates. At this stage, the use of ATLM was intensified. The exercise was structured in three main elements: a) a public notification, which should include the description of what would be done, the objective, the necessary materials, and the bibliography (Table 1); b) a presentation in free format, addressing theoretical aspects related to the exercise; c) application and monitoring of the exercise with classmates. The stages of the discipline and the steps of the exercise are illustrated in Figure 1.

Each team was responsible for providing the materials for the activity, with completion expected within the class schedule (4 hours). The other classmates should participate in all activities, try to solve the exercise, and evaluate their positive and negative points through constructive criticism. The team members who conceived the exercise guided and assisted classmates in the activity and recorded the process through photos or videos.

For the exercises, the students had complete freedom in choosing materials. The work could be done by hand or using the machinery available in UFSM's Technology Center (CT) prototyping laboratory called ***Fábrica CT***. Support and follow-up classes were provided before practical application to guide each group.

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Teaching Strategies in Architecture and Urbanism					
Code:	DAU 848	Nature:	Elective	Offer:	PPGAUP
Class:	2023.1	Credits:	3	Classroom hours/ total:	45
Professors					
Objectives					
General objective: to develop signs for predetermined spaces in the CAU/UFSM through parameterization design and digital manufacturing. Specific objective: to present the contents related to signage, LBI, Associacäo Brasileira De Normas Técnicas [ABNT], NBR 9050/2020, and operation of 3D printers available at the factory, Fábrica CT. To design signs for CAU / UFSM. Model in 3D program. To print them on a 3D printer.					
Content					
Signage, NBR 9050/2020, Universal Design, Accessibility, 3D prototyping					
Methodology					
An opening speech introduces the concepts related to signage, LBI, and ABNT NBR 9050/2020, highlighting the requirements of the standards and their importance within collective environments. The class is then divided into groups before presenting the practical class activity. During the activity, the groups have time to search for references and brainstorm, which allows for later presentations of ideas and discussions among all students. Soon after, the project starts using SketchUp software and is exported to Cura. Finally, the groups present their final products and discuss the exercise. The signs will be printed as per Fábrica CT's availability.					
Schedule					
- Presentation of relevant concepts on signage – 10min; - Presentation of the Brazilian Inclusion Law and its mandatory compliance in architecture and engineering projects – 10 min; - Presentation of the chapters on the signage of doors and corridors and their basic concepts from ABNT NBR 9050/2020. 15 min; - Organization of the groups and presentation of the activity – 10 min; - Time for students to search for references and brainstorm within the group for the signage project – 30 min; - Presentation of alternatives and discussion of ideas among all students – 25 min; - Modeling and export time to Cura – 45 min; - Final discussion of the exercise – 20 min.					
Assessment					
Students will be evaluated according to their creativity in creating signage, the functionality of their results, and their compliance with the ABNT 9050/2020 requirements.					
Resources					
Laptop; SketchUp Software; Cura Ultimaker Software; Internet; projector or television; 3D printer.					
Bibliography					
ABNT-Brazilian Association of Technical Standards. ABNT NBR 9050/2020: Acessibilidade a edificações, mobiliário, espaços e equipamentos urbanos. Rio de Janeiro, 2020. BRAILLE TRANSLATOR. Simple and free resource to convert texts to Braille, c2022-2023. Home page. Available at: https://www.tradutorbraille.com.br/. COSTA, Joan. Signage, from signage to program design. Encyclopedia of Design, 1989.					

Table 1. Example of plans made by students. Source: Prepared by the authors, 2024.

PROCESS

Four teams of students designed exercises related to the subject, as shown in Table 2. Below, each exercise is described, and relevant aspects that influenced them are discussed.

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Team	Team members	Purpose of the exercise	Professional training of the team	Duration of the exercise
Team 1	3	Develop signage boards for pre-determined CAU spaces through parameterization design and digital manufacturing.	Architecture and Urbanism Civil Engineering Industrial Design	4h
Team 2	3	Apply a didactic game about accessible circulation in architecture with concepts, pictograms, accessibility, routes, and barriers.	Architecture and Urbanism	4h
Team 3	2	Develop a tactile map for CAU.	Architecture and Urbanism	4h
Team 4	2	Develop accessible urban furniture aiming to promote awareness on the subject.	Architecture and Urbanism	4h

Table 2. Organization of the teams for the exercises. Source: Prepared by the authors, 2024.

Figure 2. Signage. Source: Prepared by the authors, 2024.

Team 1

Team 1's objective was to develop 3D-printed signs for predetermined spaces of UFSM's Architecture and Urbanism [CAU] building: public toilets, elevators, and the PPGAUP study room. The signs should consider the contents related to the signage, the Brazilian Inclusion Law [LBI] (Brazil, 2015), and NBR 9050/2020 (ABNT, 2020).

Initially, those responsible for the exercise presented, through an exhibition class, the relevant concepts on signage, LBI, its mandatory nature in architecture and engineering projects, the signage of doors and corridors, and the basic concepts of ABNT NBR 9050/2020. After the class, the course was divided into groups of two to three students to create the signs. The groups searched for references and brainstormed while receiving guidance on standards, prototyping software, Braille texts, and model design. At the end of the period dedicated to creating the signs, the teams presented their models to the class. This phase was used to evaluate the work collectively regarding the fulfillment of the requirements, the originality of the models, and the clarity of the signs' messages. In addition, this helped plan 3D printing on the available equipment. Finally, the signage was prototyped, as illustrated in Figure 2.

After 3D printing, the participants debated the dynamics of the exercise, identifying flaws and suggesting possible improvements. It was found that

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the absence of photographs of the places where the signs would be installed hindered the exercise, as the students needed to understand the characteristics of the environment. Likewise, there were no measurements or explanations on aspects to be considered for each sign, which made it challenging to design and define criteria for viewing and installing them. Another point raised was the need to include an explanation of the types of typographic fonts and the most appropriate colors for signage in the exercise's initial presentation.

Finally, the students were encouraged to use 3D printing and praised the technology's possibilities. However, they noted the need for further technical studies to avoid errors in prototyping. This aspect can be observed in Figure 2, which shows one of the models with poor quality due to an error in the digital modeling.

Team 2

Team 2's exercise consisted of a didactic game on architectural paths and barriers, adapted from Victorio's doctoral thesis in architecture (2023). Through an exhibition class, the group presented content on circulation in built and urban environments, LBI-based accessibility, and the concepts of pictograms, routes, barriers, UD, and accessibility. In addition, the main rules of the game, called "Concept and ideation," were explained.

The game consists of a board, tokens, objective cards, opportunity cards, concept cards, path cards, barrier cards, and blank cards for solving the barriers. In addition to these components, you need drawing materials, such as a pencil, pen, eraser, and dice. The concepts and pictograms used in the game were outlined and presented in Victorio's master's dissertation (2019), while their structure, components, and rules are detailed in Victorio's doctoral thesis (2023).

Briefly, the game works as follows: the board has four paths, and the objective is to move from one point to another, forming a path using the path cards, which are chosen and placed on the board (Figure 3) according to the concept cards that the player has in hand. Another objective is to relate the photos of the path cards with the pictograms of the concept cards printed on the back of the path cards, allowing comparison at the end of the game. Tokens mark the player's path, while barrier cards must be solved to clear the path. On the other hand, the opportunity cards work as wild cards, helping to overcome obstacles. The game ends when all players reach the destination; at that point, all path cards on the board are turned over to compare the pictograms with each player's concept cards.

The class was divided into two groups of four people for the game, encouraging discussions between the participants. The students were evaluated based on their game scores, creativity, understanding, and ability to analyze routes and solve the presented barriers.

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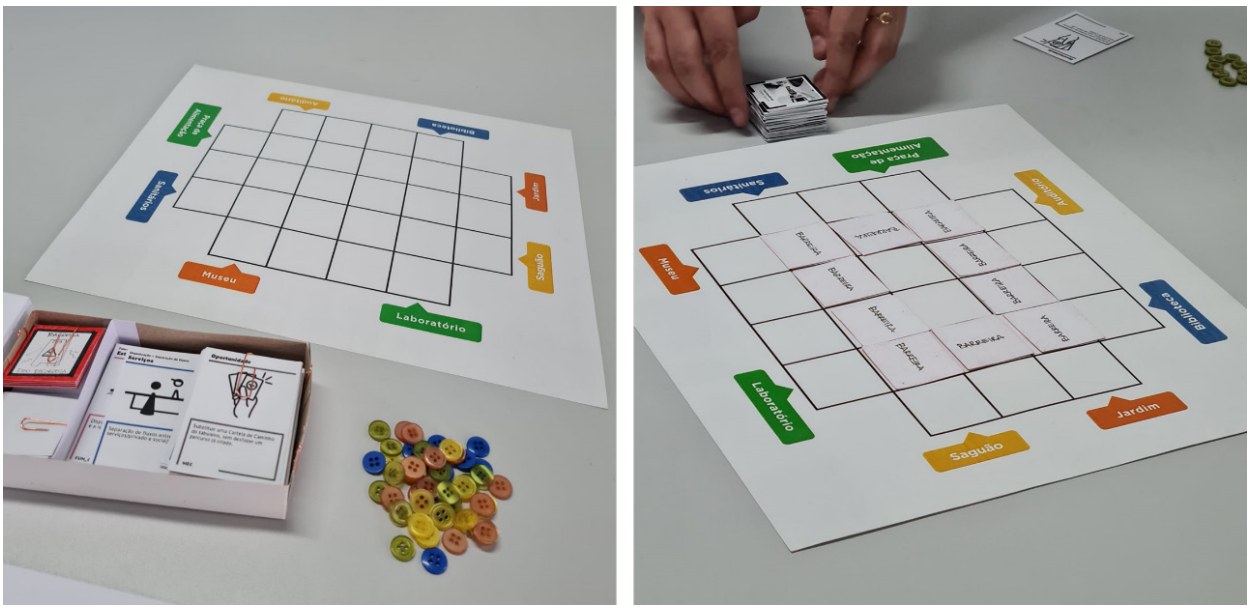

Figure 3. board game. Source: Prepared by the authors, 2024.

The students considered the exercise interesting and fun, expressing positive opinions about the topic and the game's playful approach. The possibility of enlarging the board to create longer paths and introduce more barriers, making the gameplay more challenging, was also discussed. The difficulty in linking the images to the barriers' pictograms was also pointed out, which generated doubts and conflict among the participants. Based on the classroom observations, it was suggested that, before applying the practical activity, the theoretical class include an introduction to the concepts and pictograms that Victorio (2019) developed, assisting the players in associating images and pictograms.

In addition, it was recommended that some game components, such as the tokens and barrier cards, be replaced with colorful 3D-printed parts, making the game visually more attractive. The activity proved an effective alternative for learning about UD, accessibility regulations, and architecture and urbanism projects accessible to audiences with special needs. The game was engaging for the participants and promising as a playful teaching tool. It also facilitated a joint discussion between players, students, and professors about accessible solutions to the accessibility barriers presented in the game.

Team 3

Team 3's exercise aimed to make a tactile map of UFSM CAU using different handmade materials. The exhibition class for the exercise addressed the history of the tactile map, the most commonly used materials, manufacturing methods, and the Braille writing process, which was demonstrated with a ruler and punch. The UFSM Coordination of Educational Actions (CAED, in Portuguese) loaned the materials needed to write in Braille.

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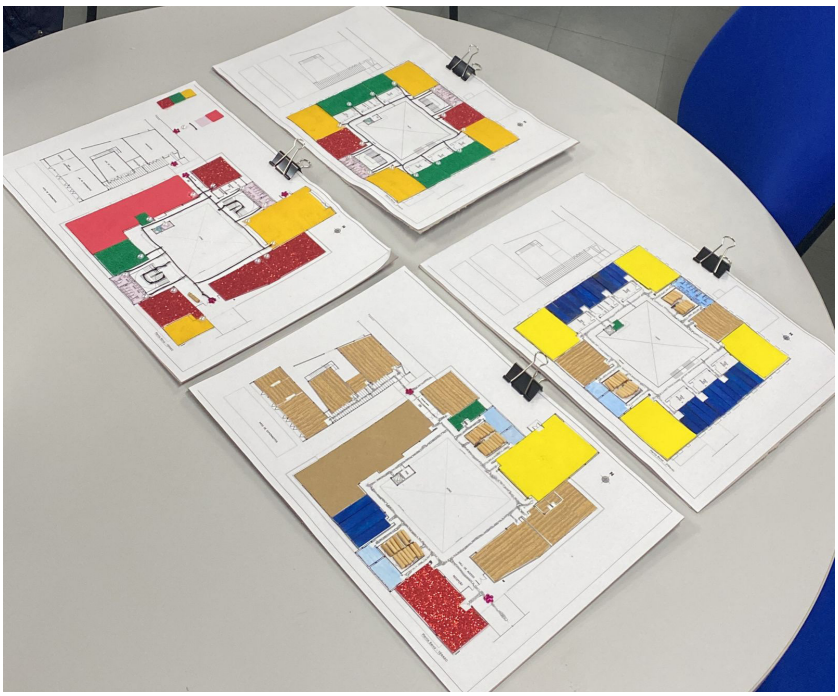

Figure 4. Tactile maps. Source: Prepared by the authors, 2024.

The students were divided into two groups of three members, each responsible for representing the ground and second floor of CAU. The maps were made using glue, scissors, adhesive tape, colored threads and cords, paper, buttons, and beads (Figure 4). The groups had to follow a basic zoning of the environments, identifying workshops, theoretical classrooms, laboratories, toilets, service areas, teachers ' room, and auditorium. It was also necessary to differentiate the paths and access to the spaces. At the end, each group presented its proposal, and discussions were held about the results obtained. The evaluation considered both the map's completeness and the use of creative solutions to represent the spaces.

In the final discussion, the different forms of demarcation used by the groups were observed, especially on the rooms' doors. While one group used beads as a reference, the other cut out textured foam and positioned it in front of the entrance. One group used lines to mark the paths, while the other chose glitter glue.

Among the suggestions for improvement, the need for more time for the activity and the possibility that the base map already had some previous demarcations of the limits of the environments were highlighted, thus optimizing the process. It is concluded that the activity achieved its objective, allowing students to experiment with different textures to represent the environments and get to know the Braille handwriting process. For future editions, it is recommended that visually impaired people participate in evaluating the maps produced in the classroom.

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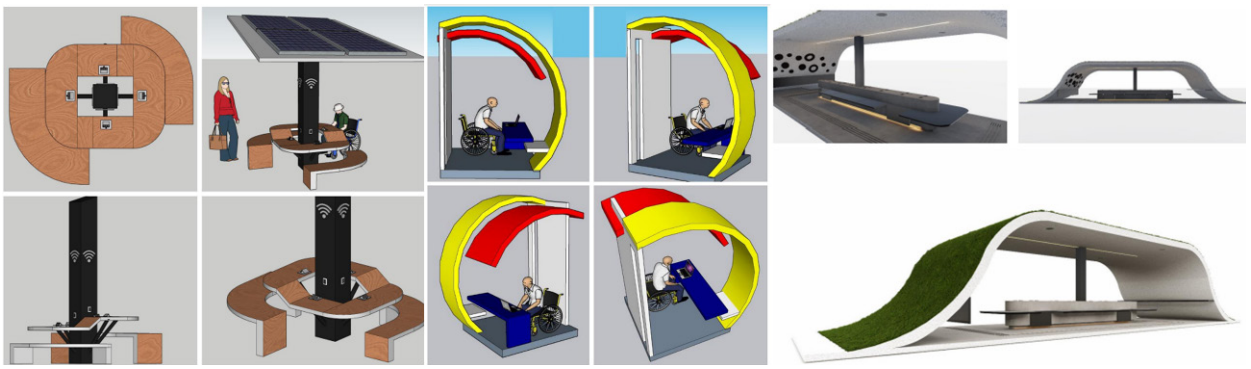

Figure 5. Accessible urban furniture. Source: Prepared by the authors, 2024.

Team 4

Team 4 sought to develop accessible urban furniture. The exhibition class presented content on urban furniture and the NBR 9050/2020 and examples of existing furniture, so students became familiar with the topic before starting their projects. The class was divided into three pairs, each responsible for designing furniture adapted to a specific user: blind people, wheelchair users, and little people. The teams had the opportunity to explore different approaches to creating accessible street furniture, considering the particular needs of each group. Teamwork enabled the exchange of ideas and promoted a broader understanding of these users' various limitations and challenges.

Projects could be submitted in physical or digital format. At the end of the exercise, the students presented their proposals and participated in a discussion about the ideas. The evaluation considered the creativity in furniture design, the projects' functionality, and its relationship with the principles of accessibility and Universal Design.

During the presentations, students explained and justified their choices and approaches, demonstrating an in-depth understanding of the accessibility and inclusion demands met by each proposal. Figure 5 illustrates the proposals' presentations, where the groups exhibited their projects in a three-dimensional format on television.

In Proposal A, the Wi-Fi booth was designed to focus on people with dwarfism, but other users could also use it. The furniture has 2 levels, with one portion of the table at 55 cm high and a seat at 30 cm, while the other has a table at 70 cm and a seat at 45 cm. In addition, a part of the seat was suppressed to allow use by wheelchair users, both adults on the highest level and children on the lowest level. The seats and table are designed with curved shapes, allowing more people to utilize the space simultaneously. The furniture has four triple sockets on the tables and two more on the pillar. To make the structure sustainable, photovoltaic panels were added for power generation.

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In Proposal B, a booth was developed for wheelchair users. The project starts from a module with a central bench, where power supply points are located in two places, ensuring accessibility for wheelchairs and other users. In addition, the modules can be mounted singly or combined side by side, providing greater flexibility of use.

Proposal C's public Wi-Fi station is designed for people with visual impairments. To facilitate its identification in green areas, the structure features high color contrast and retractable seats, allowing more flexibility to users. Tactile floors were incorporated to facilitate the movement of people with visual impairments, and sound boxes were used to provide essential information and assist users. The structure is open on both sides, avoiding obstacles and minimally interfering with the space where it will be installed.

With the collective presentations, it was possible to understand each project and the furniture's development process, which, although different from each other, provided accessibility for their respective audiences. All pairs sought to expand the number of users contemplated, aligning their projects to the concepts of UD. However, the three groups delivered their projects in 3D images, without Floor Plans, side views, or other forms of representation, which made it difficult to understand and verify specific measurements. This highlighted the importance of previously defining the format and the items to be delivered to ensure a more complete and detailed presentation.

At the end of the presentations, the groups discussed their perceptions about the activity and the relationship between the projects. They provided a broader analysis of the class and identified points that could be improved in future reproductions of the experience.

FINAL DISCUSSIONS

The four teams conducted dynamic exercises that can be applied in undergraduate Architecture and Urbanism courses, stimulating awareness about Universal Design and users' relationships with the built environment. At the end of each activity, students identified opportunities and challenges between the initial planning and its application in class, discussing the adjustments needed for each case.

Although not all teams used prototyping, the students debated how the technology could be incorporated into the exercises, concluding that only a few adjustments would be needed for the initial proposition. The importance of perfecting the exercises was also discussed, complementing the theoretical part presented in the initial presentation to facilitate the understanding of who will perform them.

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Also, the stages before the exercise – where teaching in Architecture and Urbanism courses and the teaching of UD were discussed – proved sufficient to encourage reflection on the topic. ATLM was present from the first two stages, encouraging students to seek bibliographies outside those proposed by the subject and enriching exchange and discussion in the classroom. However, its application became more active in the third stage, when, after the theoretical foundation, the students needed to conceive and develop an exercise for their colleagues.

Regardless of working in teams, the students received support and advice from their classmates, which ensured the multidisciplinary exchange of knowledge, enriched by the class's different academic backgrounds.

CONCLUSIONS

Active Teaching-Learning Methodologies (ATLM) in student-centered learning stimulate creativity in solving problematic situations and proposing different solutions to the same challenge. With the inclusion of Universal Design (UD) in Architecture and Urbanism courses and engineering, ATLM emerges as one of the learning methodologies capable of encouraging students to reflect on the subject, addressing both theoretical and practical aspects of the relationship between different types of users and the built environment.

The objective of this article was to present the work implemented in PPGAUP's "Teaching Strategies in Architecture and Urbanism" subject. It focused on the final exercise, which used ATLM for UD lightning exercises and explored the potential of prototyping technology. As a result, four teams conducted exercises addressing furniture, gamification, tactile maps, and signage. Each proposal brought a unique perspective on UD in architecture and urbanism teaching, resulting in distinct products and contributing to the diversification of approaches to accessibility in the academic environment. After applying the exercises in class, at the end of the course, possible improvements were identified for future editions of the activity.

In short, the final exercise successfully promoted awareness of UD in the built environment by engaging students in developing inclusive and creative solutions. By addressing interdisciplinary and practical topics, the activity provided students with a broader view of the possibilities and responsibilities of the architecture and urbanism professional regarding accessibility and the promotion of equal opportunities for all.

AUTHOR CONTRIBUTIONS CRediT

Conceptualization, S. DP., V. D.; Data curation, S. DP., V. D.; Formal analysis, S. DP., V. D.; Obtaining funding, V. D.; Research, S. DP., V. D.; Methodology, V. D.; Project Management, S. DP., V. D.; Supervision, S. DP., V. D.; Validation, S. DP., V. D. Writing - original draft, S. DP., V. D.; Writing-proofreading and editing, S. DP., V. D.

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