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Inclusive Architecture: Landscape Codesign in Children's Playgrounds

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Abstract: Children's playgrounds are open spaces, the basis for children's recreation, important for the inclusion and mobility of visually impaired children in the social environment, through inclusive urban facilities that stimulate new experiences for their cognitive development. In this context, the use of co-design with visually impaired people, in the design processes of children's playgrounds, assumes an importance for an inclusive project based on their experiences. Thus, it aimed to promote a project together, to provide more comfort and safety to users. It presents as main results as better colors, materials and types of toys for children with visual impairment to be competent in a playground including from the application of methods, tools and resources in the co-design process.

Key words: Co-design, children's playgrounds, visually impaired people.

1. Introduction

Cavalvanti et al. [1] defend the joint architectural design, being able to recognize the design preferences and strengthening a collective, having as one of the main objectives the better identification of the needs of the users who will live in the place to be designed.

Collaborative projects (PC) better known as co-design are currently used for the purpose of design improvements with professionals or collaborators from different areas of expertise, generating a partnership of mutual purpose, working in architecture, urbanism, interiors or landscaping, being these are the most used by professional architects and urban planners.

People who were born or became blind in a short period do not have a visual frame of reference, a concrete visual image. Therefore, for their spatial perceptions, they need to rely on information from sensory organs other than vision, such as touch, hearing and smell to understand their accessibility and comfort in an environment [2].

Multisensory experiences in nature according to Pallasmaa [3] are necessary and healthy, promoting integration of the senses where vision collaborates with what the body already feels, the aroma, the feeling of plants, furniture and spaces. Architecture becomes a natural extension, supporting the perception of environments, transmitting the experience of understanding the world through contact, essence and listening in nature.

To PC in leisure spaces, people with Visual Impairment (People with Disabilities (PwDs)) act mainly with their daily experiences, becoming great allies for architectural projects. According to Carneiro et al. [4] the performance of the PwDs provides more information for design adjustments, thus, there is exchange of information, experiences, stories and an in-depth study to make the place to be designed inclusive and appropriate to the theme.

This research aims to apply co-design methodologies in joint leisure spaces to the daily experiences of blind and low vision people through techniques, methods and tools applied in the inclusion of PwDs in the landscaping project process. The

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techniques used in the research are Workshops, Accompanied Walks, Focus Group (FG) with semi-structured interviews and use of plants and tactile models with the use of digital fabrication, being a tool for the means of communication, which in this case will be the tactile model in the practice of codesign between the designer and PwDs. This research is part of studies developed since 2013 by the Research Group of Innovation and Technology in Architecture and Urbanism (NITAU) at the Faculdade Meridional (IMED) [5].

2. Methodology

Co-design is a process of elaboration of projects and products, applied in architecture between designers and users, with the objective of integrating them in the elaboration of project processes (PP). Its processes assume that joint creation favors an adequate and more serviceable result for the user, varying its methodologies, tools and application resources for each project [6]. For the co-design of landscaping in a children's playground, some methods, tools and resources extracted from the literature review on the subject will be used, which will be explained in this research fragment.

The methods, tools and resources adopted in the elaboration of the Collaborative Project of the Mario Bernardi square with the PwDs were developed in stages, carried out through workshops with sensory games, use of digital fabrication to produce tactile models, accompanied tours and Focus Groups (FG) associated with semi-structured interviews, promoting constant feedback from users and establishing effective participation with the project.

The strategies adopted for research are based on a comprehensive view of everyday events in PwDs, enabling a questioning and understanding of the behavior of individuals regarding recurring difficulties in leisure spaces. Information that will guide the development of project realization or modifications will result from interactions with volunteers.

The place chosen as a study for the research is square Mario Bernardi, inaugurated in 2019; it has great involvement with society, receiving families and schools throughout the week. The playground at Mario Bernardi square has a total area of 98.20 m^2, with a toy for children aged between 3 and 13 years.

The research will be concentrated on a PC for a children's playground in the square. The PC was carried out with students and teachers from the Frei Wilson João school in Marau, with a broad objective of inclusion for a universal design emphasizing in the research the 5 children with visual impairments in the school, covering all users, characteristics of the different cognitive conditions and age of children, and was carried out through a project proposal for an inclusive playground for visually impaired children through colors, textures and sounds with the effective participation of all students.

In the PC, three methods, tools and resources were applied: workshop with games that explore the sensory sense, use of digitally fabrication tactile models for better perception of environments and FG associated with semi-structured interviews.

Initially, there was a brief knowledge of the daily lives of children at school and an introduction to the designer to the students, which took place individually in the children's homes, with the designer, students and parents. There was also the application of workshops with the inclusive class, which were delivered to the children's homes, due to the pandemic, to be applied with the parents. In which the parents forwarded the results and as a result via audio or video to the designer and then transcribed it into text. The games were essentially sensory, which encourages the differentiation of colors, sounds and textures for better application of them in the design process of the square's playground. The games applied were: organizing colors, auditory memory game and texture magic box.

In the preliminary PC methodologies, there was a moment for the designer to elaborate two tactile models digitally fabricated using a 3D printer, with the intention of evaluating the digital fabrication tactile model as a means of communication in the co-design process. The first tactile model was of a leisure space at the Frei Wilson João School. This place, the students already know and become familiar with, and another one of the children's playground in the square to be reclassified.

The two tactile models were digitally fabricated, enabling communication between the group through the tactile sensor, instigating creativity and criteria for future project solutions. Through Sethi 3D printer, fused deposition modeling (FDM) system located in IMED's digital fabrication laboratory.

In the preliminary methodologies of the PC with children, the online FG was developed with the participation and assistance of those responsible with semi-structured interviews about the methods, tools and resources already applied, arguing about colors, textures and sounds for application in the project. There was also a presentation by the designer of two tactile models digitally fabricated with the aim of instigating opinions about the spaces.

Also in the preliminary methodologies, there was an FG together with semi-structured online interviews with moments when the interviewer has support material (tactile mockup) to discuss the topics with the help of those responsible, using the use of digital fabrication for opinions and discussions around like "Did anyone miss a toy in the playground? Why?", "How does it feel to use the tactile model for the perception of playground toys?", "Did you like the use of the tactile model? Why?" generating a concept and participatory guidelines that contributed to the project in which it was carried out by the designer.

3. Results and Discussions

3.1 Workshop with Games

The applicability of games with ten student children of the Frei Wilson João School, aged between four and ten years old, was used as an aid to the development of the Mario Bernardi Square Playground project. The three games: Organizing Colors, Auditory Memory Game and Magic Box were applied in the children's homes, with the help of parents, via the internet and with audio-to-text transcription.

The first game, Organizing Colors (Fig. 1), with recyclable caps, was spray-painted and circles were glued on EVA paper on top of each cap. The main colors of the game were highlighted and chosen by most children, the colors red and yellow, in which the parents highlighted that they were the two colors that most attracted the attention and easy placement for the children, assisting in the design of toys, for children with low vision to discover the toys and their barriers.

Fig. 1 Images of the participant performing the Organizing Colors activity.
Source: survey participant (2020).

Fig. 2 Images of the participant performing the Auditory Memory Game activity.
Source: survey participant (2020).

Fig. 3 Images of the participant performing the Textures Magic Box activity.
Source: survey participant (2020).

The second game, Auditory Memory Game (Fig. 2), was made with transparent recyclable material, painted with silver spray paint and placed different types of materials inside, causing different types of sounds. The most interactive sounds that the children liked the most were sand and beads. The students emphasized that the sounds were different, sand a calmer and more comfortable sound and the sound of beads, a more interactive sound, faster and stronger. They highlighted the desire for more auditory toys in children's playgrounds.

The third and last game applied to student children was the Magic Box game (Fig. 3). The objective of the third game was to seek different types of materials for the design of toys. The children found sand, a natural material, interesting and plastic a more comfortable and safe material for toys, according to the children. Wood, highlighted as the least comfortable material for the design of toys because it is the roughest material.

3.2 Tactile Models

Two tactile models were made as a means of communication between the designer and the research participants for a better understanding and use of the daily experiences of each participant. Initially, one is from the existing playground at the Frei Wilson João School where the participants already know and make use of the medium and the other from the Mario Bernardi playground, so that there is a comparison between the two models, instigating new opinions about the means of communication and the same, where they were applied during the research project methodologies.

3.3 Model Design and Materials

The two tactile models were digitally manufactured, using a Sethi 3D printer (Sethi Manufacturer from Brazil), with an FDM system and initially designed by the Revit 2020 software and later by the online software TinkerCAD.

Initially, the tactile models were designed by Revit 2020 Software and manufactured in only two solid elements, one element containing the school's playground and another one of the school's playground in which the toys were made by the Sethi 3D printer in both elements, without any processes assembly or collage, produced in just one module and plan each, with some problems (Fig. 4).

The main problem with the first models fabricated was burrs during printing, as they were a small volume, some elements were not manufactured, the

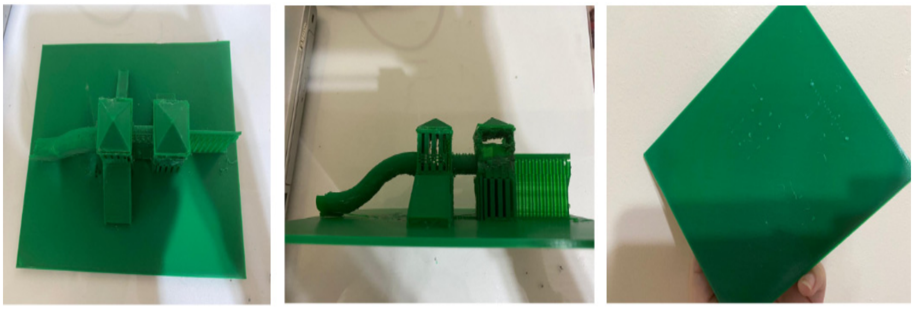

Fig. 4 Initial tactile mockup.
Source: author (2020).

Fig. 5 Tactile mockup disassembled.
Source: author (2020).

tactile model of Mario Bernardi square was just a module with several toys in which the balance did not come out during printing, the slide and the "little houses" were totally solid. A Bosh GSB 13 RE Drill and Impact Drill was used to drill the burrs and hot mechanisms were used to soften the rough places so that children would not get hurt during tactility.

In conclusion, there should be new production tests for the tactile models, so that children do not get hurt during their tactile behavior and can better understand the communication mechanism. So then, two more tactile models were produced, designed in the TinkerCAD online software.

The second project developed for the models consisted of several parts of each model, thinking about an assembly process, so that there would be no burrs during printing and the children could be better able to feel them. Forty-five pieces were developed between the two models, requiring an assembly and collage process (Fig. 5).

Initially in the assembly process, right after printing, a bonding test was carried out with glue, but it was not successful because the glue easily peeled off the material used for making the model. During the process of assembling the models, some aid materials were used, such as hot glue to join the pieces, scissors to remove excess glue and malleable material to join the balance pieces, concluding that the best way of gluing the material was hot glue with mechanisms for removing excess, as shown below in the models already made.

The material used as support for the tactile models was the plains of the previous model, with processes for placing digitally manufactured toys on top for demonstration to research participants.

3.4 Application of Tactile Models to the Research Group

The applicability of the tactile models occurred with ten students from the school Frei Wilson João, aged between six and ten years old, four children aged six, three aged seven and the other three aged ten years, in which six of them have visual impairment, low vision.

The testing of the means of communication took place at the children's homes through a kit delivered, carried out with the help of the parents and the designer. There is an FG together with the semi-structured interviews as material for the models, debated online through discussion topics.

Initially, mockups of toys already present at the school were demonstrated, eight of the ten participants have already recognized the toys present at their school, as a slide (Fig. 6).

Still addressing the tactile model of the school, he was instigated on the sensation of feeling and getting to know the school's playground in a smaller staircase, which they use. The children said it was interesting to feel where they already know, some also instigated about editing, wanting to be part of the editing process from the beginning. Having the most interactive toy on the school's model, the swing is cited by some parents as the most inclusive.

After the demonstration of the tactile mockup of the school's playground, the square's playground mockup was presented, in which some children approached that they had already made use of the place, but that they missed feeling the slide and the stairs, not present in the mockups due to burrs.

During the comparison of the two tactile models in the FG, the children mentioned that different toys as in school are more interesting and not just a module, which may have more space and diversity of toys.

They also discussed the materials used in the models, in which four of the ten participants instigated "Why is the floor of the model green? Will it be grass? And why are the models only white? Won't it have color?" demonstrating how color typology interferes with tactility, as contrasts are important for children with low vision.

The application of the two tactile models occurred freely, in which the children could make use of their toys, such as on swings in which they used other toys as a way of throwing through the elastic, generating other types of toys in the creative process.

The last topic addressed was whether the children liked using the models as a means of communication. All mentioned that they loved it; some would make use again of the model of other spaces as well as streets and sidewalks and mentioned that it was interesting for them to participate in the research to design spaces for themselves.

The use of digital fabrication as a means of communication for the Mario Bernardi Square Playground project concludes by addressing the importance of using the models, as the daily experience of each user together with the parents' opinions will help productively to design the project. The Playground project will support future projects using digital fabrication to create mockups as a means of communication between designers and people with visual impairments.

An infographic was created (Fig. 7) with pros and cons suggested by the research participants about the use of this means of communication during this research project with the children and their images using the models (Fig. 8).

Fig. 6 Tactile mockup.
Source: author (2020).

Table with pros and cons when using the Tactile Mockup	
Pros	Cons
Helps visually impaired children interpret spaces.	Color typologies, assemble more contrasting pieces, not just one color.
Means of communication to extract productive daily experiences to make the project more assertive.	
Explore the tactile sensor of children without disabilities.	

Fig. 7 Table with pros and cons suggested by research participants on the use of the media.
Source: author (2020).

Fig. 8 Images of the participant performing the activity with tactile models.
Source: survey participant (2020).

4. Conclusions

Through the development of this research project, it was possible to explore new methods, tools and resources of Codesign in landscaping used as a tool for inclusion of PwDs in PP in architecture and landscaping, establishing some characteristics for the processes and products, also resulting in a more assertive project.

During the PP all objectives were achieved, through applied methodologies, such as workshops, activities and FG with semi-structured interviews. In which, some objectives were adequate in the face of the pandemic, as an example in which some planned methodologies were going to be applied in a formal environment, at school, but ended up being applied in an informal environment, and with the help of those responsible, in the homes of the research participants.

A playground project was prepared with guidelines based on the activities applied with the research group that was not included in the article. There is also a stage of the research work that will remain for future projects, the presentation of the playground project with a moment of Codesign feedback during the PC to the research group that due to the pandemic should be postponed, to be carried out in a formal environment in the future.

Concluding that this research project materialized new methods, tools and resources of landscaping codesign in children's playgrounds, in which, from the applied methods, it was possible to state that the codesign process with users helps in the final result of the project, making it more assertive. With positive testing of tactile models applied to children participating in the research, they previously had not tested with visual impairment.

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