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Daniele Villa
Franca Zucconi *Editors*

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The Effectiveness of Digital Visualization Tools to Enhance Co-design Activities in Urban Planning

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Abstract. The paper investigates the use of digital visualization tools to strengthen students' skills in understanding and leading urban co-design processes. To avoid the risk of being tokenistic, these participatory paths should rely on new methods able to implement the citizens' interpretative capacities and involving them as early as possible in the planning stages. A pilot case study application has been planned to let the students test an original co-design strategy, consisting in a combined use of the exp-EIA[©] method, coupling architecture and psychology, and a web-based platform for team collaboration. The main hypothesis was that this approach can contribute to implement their competencies about the emotional, cognitive and community components of urban experience. The sample consisted of 38 Master of Science international students of the Politecnico di Milano (School of Architecture), and the study focused on the university area, the Città Studi district. The results shows that a new awareness about the importance of psycho-social dimensions as crucial factors for urban planning processes has been promoted in the participants. Their consideration of planning as a systemic synthesis of various subjective and social instances was also strengthened. Our pilot study stressed the critical role of visualizations in implementing an efficient online learning experience, impacting how students perceived information, valued the process, and would positively manage future co-design activities in their professional practice.

Keywords: architect education · Co-design · environmental psychology · virtual reality · web-platform

1 Introduction

“Knowing” and “being able to distinguish” are two of the meanings that the verb “to see” incorporates from its Sanskrit root. In the field of architecture teaching, the importance of being able to see what exists and foresee possible developments is well known. Vision is not enough (Pallasmaa, 1996), indeed students should learn to conceive and

pre-assess the overall sensory and experiential implications of their design projects, beyond the environmental sustainability performance. This should be done having in mind the – often diversified – population living that environment. Indeed, this human-centred and design-for-all approach in architectural education is crucial for delivering to students the proper background to face the urgent needs of inclusiveness stressed by the Sustainable Development Goals (see SDG-11) and reaffirmed by the UN-Urban Design Agenda. Teaching architecture students to consciously address the subjective and community experience in the design practice is a relevant educational objective contributing to foster the United Nations goals and promoting an ethical design route. Recently, this ‘community design’ perspective seems to emerge as a learning approach, even if it is far for being a mainstream educational practice (Salama, 2015). This ‘unconventional pedagogical model’ implies the need for a ‘field experience’, i.e. “a direct encounter with the phenomenon being studied rather than merely thinking about it or only considering the possibility of doing something with it.” (Salama, 2015, p. 2018). This educational goal can be linked to the fundamental co-design idea that engaging people as early as possible and maintaining their involvement as far as possible in the overall process profoundly impacts the development of places (Wilson, Tewdwr-Jones & Comber, 2017). Hence, architecture students should experience first-hand these process as they do when going to visit building-sites. This participatory process is particularly relevant to investigate the subjective reactions of citizens to (i) existing urban areas, in order to prepare the design brief or (ii) urban design projects, to inform the project development. Indeed, not all people react the same way to an urban environment (Thiel, 1997). Many benefits can be observed in involving the public in urban planning processes, even though the approach entails a few challenges in its implementation (Innes & Booher, 2016), and, consequently, the levels of adoption in Europe remain low. One of the main causes for the public’s reluctance in being involved in planning activities have been identified in the rigid parameters of urban planning systems and procedures for urban design project approval (Conroy & Evans-Cowley, 2006) jointly with the difficulties in communicating the sense of urban design projects, and the lack of effective communication and interaction with the public (Jannack, Münster & Noenning, 2015). Considering these difficulties of interaction with the final users in urban planning practices, co-design approaches with their user-centred approach are a fruitful resource (Sanders & Stappers, 2008), as they have shown their profound potential to activate lay people from the initial stages of urban and architectural projects specifically during the ideation and generation phases (Chowdhury & Schnabel, 2019). In alignment with the attempt made by many authors (Sanders & Stapper, 2008; Foth, 2017; Lember, 2017; Dudau et al., 2019), we envisage co-design as the practice of collaborative research, in which people express personal knowledge and share their skills and resources, working together towards a common goal. This collaborative approach generates new knowledge in return. This offers a novel perspective on the stakeholders’ roles within the collaborative activities, highlighting the final users’ valuable participation and conferring them a new role as active contributors through each step of the process (Piga, Cacciamatta & Boffi, 2021). Consequentially, also designers’ role has increasingly changed over the past decade. Designers have moved substantially closer to the final users, not simply being supervisors relying on their ability to include users’ perspective and opinions into the design process. They have become also facilitators

in charge of establishing an empowering, productive and creative environment that can stimulate and activate users to express themselves (Cantù & Selloni, 2013), supporting mutual learning between multiple participants in a collective decision-making design process.

2 A Brief Literature Review

Over the years, participatory design in urban planning has often been tokenistic, meaning that the engagement only occurred too late in the design process to affect decisions that could profoundly impact it (Oliver & Pearl, 2018). Commonly, public disagreement arises in the late phases of the design process, when the design schemes become easier to understand for non-specialists but significant resources have been already spent and the possibility to influence and generate change becomes challenging and costly. Thus, it is highly beneficial and most meaningful to enable public participation and co-design activities from the initial phases of a project, at a moment when multiple and feasible changes can be implemented. This renewed approach consequentially requires new skills and competencies from experts to adequately interact with the larger public, especially in the early project stages (Jannack, Münster & Noenning, 2015). This change is largely affecting both the design and architectural practice and the field of education and research (Sanders & Stapper, 2008). Many architectural schools are moving away from a more traditional approach that just focuses on individual abilities and functional techniques, and going towards a participatory model (Hasanin, 1997) that encompasses human needs such as identity, sense of security and belonging, personal aesthetics and social interaction in its design approach. The participatory model primarily “aims to shape the skill, knowledge, and sensitivities of students and enhances their lateral thinking as well as their problem-solving skill” (Pryia, Shabitha & Radhakrishnan, 2020: 1).

One of the most challenging activities students face in this collaborative model is collecting information from the users and translating these intangible aspects into actions and defined directions to improve the initial idea at the basis of the project. At the preliminary phase of the design project, indeed, they are required to determine the main concept and define the priorities reflecting the users’ needs and desires, expressed and non-expressed. As new technological tools and methods become more powerful, more spread and more user-friendly, new possibilities to process and visualize information arise, accordingly with their potential to interact with and engage the public, and support urban planning and design professionals to enhance participatory practices in their design approaches (Al-Kodmany, 2001). In such perspective these tools can enable meaningful public participation and co-design activities at the front-end phases of the design process (Piga et al., 2021), especially exploiting their visualization features for experiential simulation (Piga, 2017). In addition to the Augmented Reality (AR) and/or Virtual Reality (VR) functions for environmental simulation, digital tools represent a crucial asset during nowadays generative sessions, since they provide visualization tools that can enhance participatory activities (Reyna, 2013).

3 An Experiential Educational Approach and Procedure

As suggested by some scholars (e.g., Salama, 2015), despite the importance of human factors for design, the psychological sphere is still scarcely connected with the architectural one. Moreover, it has been noted (Boffi & Rainisio, 2017) that architecture underestimates the importance of phenomenological approaches developed by social sciences. Relying on such reflections, we designed the exp-EIA[©] (experiential Environmental Impact Assessment)¹ method to assess the psychological aspects of the people-environment relationship. Such method is conceived for participatory processes supporting urban transformations, yet presents positive effects also from a pedagogical perspective. In fact, it can be applied for educational purposes with two main procedures: (i) using the exp-EIA[©] method for involving final users and assessing the design project by the student/s; (ii) involving directly students as final users, hence assessing the urban environment through their eyes. This second method is presented in this contribution. Being involved as participants, architecture students have the opportunity of comparing the direct experience they have in a familiar neighborhood with a structured analysis carried out using psychological constructs. This increases their skills in interpreting the results and makes them more aware about the implications of such data.

More in detail, the exp-EIA[©] method puts the experience of current and future urban space at the core of the citizen engagement process (Piga et al., 2016). Exp-EIA[©] is based on a hybrid conceptualization that brings together architecture and environmental psychology (Piga & Morello, 2015). This means that the process is not limited to a mere (late) consultation of citizens' preferences, but aims to create a complete recognition of their (current or future) spatial experience in its emotional, cognitive and identity aspects (Rainisio, Boffi & Riva, 2015). To favor the reconstruction of the link between the architectural elements and the subjective experience, exp-EIA[©] developed a complete spatialization of the emerging data on various psychological constructs from the literature. More specifically, it explores the emotional state elicited by places (Russell & Pratt, 1980; Panek, 2019), their interpretation in reference to individual cognitive schemes and mental maps (Kaplan, 1987; Lynch, 1960), the place and community bonds that people establish (Altman & Low, 1992; Manzo & Devine-Wright, 2013).

To fulfill the pedagogical potential of this method through a 'learning by doing' experience, an educational process was designed aiming at supporting a human-centred, inclusive, and evidence-based approach to urban design. This educational process aims at fostering the students' ability in foreseeing the livability generated by design solutions, or in other words the "well-being of people in the physical environment" (Piga & Morello, 2015, p.6). At the same time it supports the understanding of the potential role of citizens' participation from the early stage of urban design and planning. The process makes use of digital solutions enabling a real time computation of results; the responsiveness of such tools is of great importance for informing the ongoing activities and for making the entire process more salient.

¹ exp-EIA[©] - experiential Environmental Impact Assessment (Copyright BOIP N. 123453 - 06.05.2020 & Copyright BOIP N. 130516 - 25.02.2021 - B. Piga, M. Boffi, N. Rainisio).

The activity is designed for assessing the participants' perceptions about the neighborhood's current condition. In particular, the activity aims to strengthen students' skills in the following areas:

- knowledge about the emotional effects of urban space;
- ability to spatialize the components of a subjective experience with respect to a global description of space;
- ability to develop a critical and reflective discussion on the interaction between space and the individuals.

4 The 'Città Studi' Neighborhood Case Study

The educational process, in a form of a one-day workshop, was applied to the Città Studi neighborhood in Milan for assessing the existing urban condition. Thirty-eight students of the last year of the Politecnico di Milano, belonging to 12 different nationalities, participated in the workshop. With regard to gender, the sample was slightly unbalanced towards the female (56%) compared to the male one (40%). 4% of the participants did not define themselves in binary terms. None of them was familiar with methodological approaches concerning the psychological dimensions applied to the urban contexts' analysis. Due to the restrictions imposed by Italian national laws regarding the COVID-19 pandemic, the adopted format was a blended workshop, with some participants located in a Politecnico classroom (physically present) and others connected online.

Participants were involved in a two-step process:

- 1) During the first meeting, participants virtually explored various areas of Milan that were part of a re-design task for the Master of Science course; in addition, they explored the Città Studi area. For each exploration they answered a questionnaire referring to specific panoramic views extracted for the purpose from Streetview™, thus allowing the researchers to accurately reconstruct each participant vistas. The final visual focus on the panorama was recorded together with answers to the psychological questionnaire designed *ad hoc* by the authors.
- 2) During a subsequent meeting, final results about the participants' perceptions were presented to students by the POLIMI team to trigger a collective reflection on the received feedback and on the didactic experience they were involved in. To this purpose, some co-design activities were developed through a web-based platform for team collaboration (Miro™). More in detail, participants were invited to identify:
 - The types of information about citizens' opinions/experiences that it is important to collect in order to guide/support the design process.
 - The usefulness of this information in relation to the design stages and how to achieve this information, i.e. which sources and/or tools. To this end, six design phases have been identified: *urban analysis*, *design conception*, *preliminary design*, *definitive desing*, *executive design*, *post-construction monitoring* (Piga et al., 2021).

5 Results

The analysis of the results allowed us to investigate how the use of the exp-EIA[®] method in association with a platform for team collaboration has enlarged the participants' awareness with respect to the subjective experience of urban space. Moreover, it was possible to argue what beliefs the participants have developed about the citizens' perception, their usefulness for the design process and the most suitable ways of collecting such data according to the project phases.

Firstly, students highlighted as a priority the collection of information from citizens on four macro-variables, namely emotional, cognitive, behavioral and social aspects (Fig. 1). This subdivision corresponds to four major fields of study in Psychology, thus signaling a seminal understanding about the importance of using psycho-social variables for urban design by the participants. More in details, they identified as crucial the following information sources:

- Emotional aspects: perceived safety/security, general connection/emotional engagement with the area, attachment to specific places, spatial memories;
- Cognitive aspects: general place satisfaction/evaluation, attitudes towards local change, local knowledge/mapping, landmarks identification;
- Behavioral aspects: path/mobility analysis, daily routine analysis, space use observation dedicated to specific social targets, e.g. green areas and playgrounds;
- Social aspects: social climate (perceived affective tone of relations between residents), community engagement/public participation, presence of public community conflicts.

They also focused on the most suitable methodologies for collecting this information according to the phases of the design process. According to Fig. 2, the participants placed most of the data collection activities in the two initial phases (*urban analysis* and *design conception*) and in the last (*post-construction monitoring*) one. As regard to the first *urban analysis* phase, the participants figured it as characterized by citizens' individual involvement, applying tools aimed at aggregating subjective and objective data, mainly quantitative (surveys, digital tracing). Qualitative tools have also been proposed such as interviews and photo collections, while collective elaboration techniques (i.e., focus groups, workshops) are absent. Conversely, the second *design conception* phase is dedicated, according to the participants, to the use of group methodologies (co-design workshops, co-mapping, meetings/assemblies) only. For the following two phases, there is a general decrease in the interest for data collection and selection of information sources. In the *preliminary design* phase, AR and VR technologies appear for the first time, in the *definitive design* phase the use of forms of public consultation is highlighted (e.g., online polls). In the *executive design* phase, the focus shifts to the importance of a transparent communication about the evolution of construction site activities (e.g., progress tracking) and the potential of the urban change underway (e.g., site tours). Lastly, the *post-construction monitoring* phase is suitable to be dedicated to promoting social engagement in the new area (e.g., social events) and verifying project results (e.g., post occupancy surveys, evaluations via mobile apps).

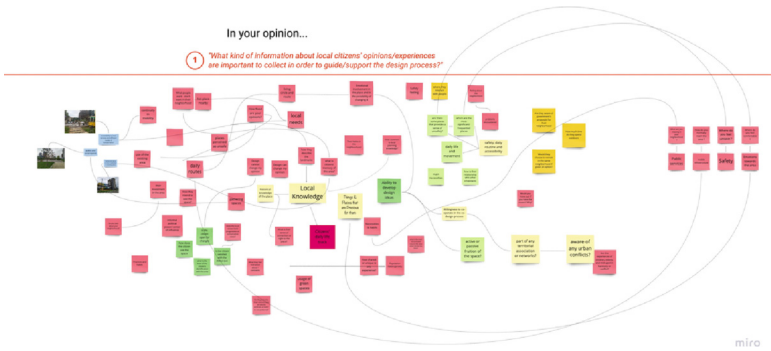


Fig. 1. “What kind of information about local citizens’ are important to collect in order to support/guide the design process?”



Fig. 2. “In which phases of the design process would you plan to collect this information? How and through which sources and/or tools?”

6 Conclusions

The educational procedure involved students as participants in a co-design process to enable them to better understand the role of participatory approaches in urban design firsthand. The application of the exp-EIA[®] method through experiential simulation in VR and the adoption of digital tools for web collaboration positively contributed to fruitfully engage and stimulate participants.

The collection of real-time feedback on the urban condition and the following collaboration through the shared board were relevant for informing the discussion as a flow of interlinked activities within a short amount of time. Moreover, the availability of visualization tools representing both the results of the people-environment relationship (exp-EIA) and the on-going debate on their implications for the design process (Mirò) eased the active participation of all students. The combination of these two aspects enriched students’ learning process and facilitated the interdisciplinary dialogue. Indeed,

as resulted from the final discussion with the students, the learning procedure contributed to emphasize the importance of psycho-social dimensions in urban design and planning processes. Consistently with the actual possibility of impacting the design solution, students envision the usage of participatory tools mainly at the beginning and after the end of the design project. Moreover, they recognize as informative some relevant research fields developed at the intersection between psychology and design sciences. Nevertheless, it is worthwhile noticing that they conceive the proposed theories and tools in a traditional way. In other words, they had the tendency to simply substitute previous analog participatory tools with their digital counterparts, without actually envisioning the potential of such ICT solutions in rethinking the entire design process.

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