P/REFERENCES OF DESIGN

DESIGN FOR CHILDREN: THE CASE STUDY OF DESIGN-DRIVEN LABORATORY AGAINST EDUCATIONAL POVERTY.

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ABSTRACT | Design for social innovation advocates for challenges Institutions are trying to align with in the evolving societal needs. This contribution reflects on the results of a series of laboratories designed and carried out at the 'Punto Luce delle Arti' of Ostia in Rome, with Save The Children, combat educational and material poverty using accessible technology. Eight workshops in different fields of creative manufacturing foster digital and manual skills, guided by computational and design thinking.

Design strategies stem from understanding social context and politics, fostering systemic change. Designers become politicized agents, transcending production, and technology to enhance social cohesion. New methods and tools emerge, defining well-being beyond economic values, emphasizing the balance of social and environmental capital for societal betterment. The Third Mission integrates University and Research with society, labor, and institutions, fostering territorial empowerment and meeting public demands for societal change. Design and education serve as strategic tools for social innovation, supporting initiatives in disadvantaged communities and empowering designers as infrastructure for autonomous development.

In the context of citizen empowerment, informal education, and STEAM disciplines fuels sustainable development and societal change. Citizen empowerment enhances community engagement and decision-making. STEAM education fosters creativity, innovation, and problem-solving through hands-on learning, offering a transformative perspective on societal challenges and promoting a "learning by doing" approach.

By these premises, the contribution offers an exemplary case study of how Design can effectively foster community building, sense making and introduce novel competences in replacing educational poverty, while advocating for a better urban development and vibrant neighborhoods.

1. Introduction

The reflection on methods and approaches that Design can adopt towards social innovation advocates the challenge that most of the institutions face in accomplishing and aligning with evolving societal expectations and specific knowledge demands (dos Santos et al., 2021). The diverse tools and strategies that can be used for this purpose stems from a symbiotic relationship between a profound understanding of social and political context (Manzini, 2018), fostering systemic change within operational contexts (Transit, 2017). Designers are called to rethink their role as politicized agents of change (Fry, 2010), expanding their impact up to a broader disciplinary field that overcomes production, technology, and market concerns (Meroni, 2007). This expansion enables new combinations of methods and tools (Villari, 2012) for social and territorial cohesion, ultimately contributing to the definition of new well-being indicators that encompass aspects beyond mere economic values, being conceived as the complementary balance of social and environmental capital (Stiglitz et al., 2009).

Within the realms of University and Research, these factors converge under the banner of the Third Mission, which bridges civil society, the labor system, and institutions. This principle facilitates territorial empowerment by enabling new forms of knowledge acquisition, competence, and skill development, aligned with public expectations and demands for societal change (Lange et al., 2019). Design and education serve as strategic tools in instigating, supporting, and enhancing social innovation beyond the academic environment, positioning designers as infrastructures to bolster initiatives for more autonomous or disadvantaged communities (Morelli & Sbordone, 2018).

To do so, it is crucial to understand the interplay between citizen empowerment and social awareness, which are factors commonly thrived through informal education and local activities derived by locals: in this context, it has been acknowledged how STEAM education can advocate for sustainable development and societal transformation (Taylor & Taylor, 2019) acting at the early stage of future civic society. While citizen empowerment garners attention as a means of fostering community engagement and participation in decision-making processes, STEAM approach and practices have also emerged as potent tools offering a comprehensive understanding of the world. They foster creativity, innovation, and problem-solving through a transformative lens and emphasize a "learning by doing" approach (Conradty et al., 2020).

By these premises, the project has been structured to have much clearer understanding of the following questions:

1. Can Design favor the creation of an environment where social inclusion and advanced technology collaboratively enhance the same educational scope?
2. Can Design in an educational context enhance the accessibility and inclusivity of those enabling technologies up to more marginalized social contexts?
3. How can education through Design stem a project culture aimed fostering cultural and social development?

To answer to these questions, the project "*Design for Children*" structured a didactic structured on a series of laboratories developed by Sapienza Design Research within the 'Punto Luce delle Arti' of Save The Children located in the Lido di Ostia Ponente district together with the local social cooperative of SS Pietro e Paolo.

The initiative has been designed to fight back educational and material poverty within the community by leveraging the accessibility of enabling technologies (Meutia et al., 2022) through eight laboratories focused on digital manufacturing in areas such as jewelry, gadget design, molding production, robotics, dynamic modelling, video creation, and serigraphy, ultimately aimed to foster the development of both digital and manual skills, underpinned by a computational and design thinking approach. Each workshop is presented and evaluated based on the skill and the competencies acquired by its young participants as well as by the technological challenge that the latter have been able to face and overcome thanks to the Design-driven approach.

Finally, the outcomes and the results of the workshops are measured based by 1) their capability to overcome the educational scope of the hosting local reality, 2) by the capability of the workshop to engage local users and stakeholders, 3) and ultimately highlighting the potential benefit it had at cultural and social level.

2. Education Through Design for Civic Empowerment

> "[…] digital has the ability to change content and form, a digital content does not remain identical but can be declined into very different versions from each other." (Magone & Mazali, 2016, p.110)

The aforementioned statement requires a deeper reflection on the different skills and abilities designers are required to have in nowadays processes and the development of technological skills. When tackling the issue of necessary update required to interact within digitalized systems, this project foreseen the necessity for a paradigmatic change that is leading the concept of education to provide the necessary knowledge and skills since the early stages of education through a "learning by doing" approach (Brown, 2009; Dziuban et al., 2018; Turakhia, 2022). Design and education acts as a strategic tool in triggering, supporting, and enhancing social innovation outside academic environment, while putting designers as infrastructures to support initiatives for those more autonomous or, so to say, disadvantaged communities (Morelli & Sbordone, 2018). Furthermore, the concept of situated learning in design education highlight the importance of authentic, real-world problem-solving experiences in architectural studio education (Buldan, 2021). This highlights the potential of design to create immersive learning environments that mirror professional practice.

Since first arguments on the role of the project in the civic context, the stability of architectural knowledge and its embedded nature within organizational practices, this stability underscores the role of designers as sense-makers, as their ability to navigate existing knowledge and drive innovation up to the social context (Henderson & Clark, 1990). In the realm of education, the people-centered and iterative nature of design thinking involves the use of specific sensible tools aimed not only to the comprehension of a context, but also to actively engage and provide fundamental tools to enable the civic society at the design process (Liedtka & Ogilvie, 2011). In the context, makerspaces can be configurated as center of learning, highlighting the significance of the physical environment in facilitating sense-making and learning (Woods, 2023). This underscores the role of designers as sense-makers in creating learning experiences that resonate with the needs and perspectives of learners, fostering a human-centered learning approach that involve and qualify the students and the teachers as enablers of conducive environments for learning purposes (Garcia-Lopez et al., 2020).

The concept of "Education through Design" (Bekker et al., 2015; Lewis, 2009; Lyon, 2016; Mentzer, 2011) encompasses diverse dimensions as design thinking offers a multifaceted approach to seek for potentialities or challenges and ultimately to envision solutions through the development of problem-solving skills (Brown, 2009; Cross, 2011; Kolko, 2015). In higher educational context, Design has already proved in many ways how it can emphasize collaboration, research, learning, and knowledge (Niederhelman, 2001). This highlights the potential of design to foster a holistic educational experience. What often is not considered is the way design can influence positively on the experience of learning (Beligatamulla et al., 2019). In this sense it could be relevant to address the importance of embracing the uncertainty that characterizes design education, which indeed often involves iterative processes, experimentation, and the acceptance of ambiguity, thriving for resilience, adaptability, and critical thinking skills among learners as well as in educators (Liedtka, 2015), thereby enriching the educational experience as a set of interaction towards common goals and achievements (Dym et al., 2005). Moreover, these highlight the role of design education in responding to social trends and needs, extending the learning environment through concepts such as Community-Based Education and Service. This bring to the attention the potential of Design to address real-world challenges and engage with communities (Tu et al., 2021), thereby promoting experiential and socially relevant learning.

Citizen empowerment means getting involved in activities that help everyone and make a difference in the community. (Lerner et al., 2009) This can lead to shared goals and positive changes. Impactful resources and solutions, in this sense, stem and derive from civic participation which involves engagement with local community, voluntary associations, local governments, that actively and collectively solve shared problems (Eccleston & Perkins, 2019; Ostrom, 1990; Sehner et al., 2022). Furthermore, empowerment programs are encouraged to provide greater opportunities for community roles in decision-making processes, especially for marginalized groups (Corbett & Le Dantec, 2018; Glowacki & von Rueden, 2015; Suwarno et al., 2019).

Social inclusion could be understood as the process of improving the conditions for the participation of individuals and groups in society, improving their skills, opportunities and dignity regardless of their identity (World Bank, 2013). In other words, a society is as much inclusive as all its individuals are valued while facing situations of marginalization and exclusion. In recent years, this theme of social innovation has become an integral part of the vocabulary of urban regeneration, where space plays a radical role in the production of this innovation (Ostanel, 2017).

> "[…] For Politics to regenerate, it must receive ideas and energy from social planning. Conversely, for social planning to flourish, expand, and endure over time, it must recursively find a favourable environment. And this, in turn, to exist, requires good Politics." (Manzini, 2018, p.4)

In his introduction, Manzini refers to *Politics* (highlighting the use of the capital *P*) as the set of organizations and actions that enables societies to thrive towards higher forms of civilization. These dynamics could also be understood as the exchange that nurtures systemic shifts within operational realms (McGill et al., 2023), which complexity underscores the need for fresh combinations of different and coherent methods and tools of design and production. This factors enables the growth of territorial empowerment opening to new forms of acquiring knowledge, competences and skills in support of public expectations and demands for societal change (Lange et al., 2019).

Said so, it could be possible to argue on the concept of citizen empowerment which has gained significant attention as a means of fostering community engagement and participation up to the decision-making processes. Nevertheless, this potential requires adequate sensibility and awareness by its users, to be considered truly impactful and inclusive.

3. Design-Enabled Technologies in STEAM Education

> "The problem will be that work itself will no longer exist and a large part of work as we understand it today will simply no longer exist." (Daclon, 2020)

The evolution of technology is driving changes in paradigms and dynamics that are impacting both the economy and society (Schwab, 2017). The reflections carried out along this project explore how those advanced models for cities livability that are aimed at citizen empowerment, are also defining the networks of information, services, and products that surround them (King & Cotterill, 2007). These models involve hybridizations and connections of processes that go beyond just the exchange of data: they structure new ways of establishing relationship between suppliers, users, interfaces, having direct consequences on the way people perceive daily life, especially in urbanized context (Calvillo et al., 2015).

Popular and participatory applications of technology are subverting traditional urban models and empowering citizens to take an active role in data collection. In this scenario, there is also another the responsibility each user is called to take towards the actions that could be made and the role each citizen cover while interacting in the system (Gatsios et al., 2020). On one hand, and among its pluralities, it could be possible to argue that *Design Research* mainly focuses on the application of competencies and skills in programs that would guide users through various disciplinary backgrounds and scientific developments (J. Li et al., 2022). On the other hand, *Design Education* integrates design thinking process into the

development of skills, providing a natural and essential component of an authentic STEAM program (Bautista, 2021). This approach fosters reflection and intentionality in Design and implementation in STEAM programs, demonstrating the ways in which design thinking can enhance student capabilities of dealing with advanced systems (Champion, 2018). For instance, in the Maker culture, the STEAM approach fosters a pedagogy model through technology that advocates for student autonomy and personal ownership throughout the design and making process (Weng et al., 2022), thereby enhancing student motivation and sense of ownership. This highlights the role of Design as culture in shaping educational experiences that foster a sense of agency and ownership among learners (Y. Li et al., 2019). In this context, it is important to consider the connection between citizen empowerment, informal and STEAM education can promote sustainable development and societal transformation (Taylor & Taylor, 2019).

If the citizen empowerment has gained significant attention as a means of fostering community engagement up to the participation in decision-making processes, at the same time, STEAM practices have also emerged as a powerful tool that offers a more comprehensive understanding of the world by fostering creativity, innovation, and problem-solving through a transformative view and a particular attention for a "learning by doing" approach (Conradty et al., 2020). At the same time, STEAM practices have also emerged as a powerful tool for enhancing innovation and creativity. In this context, it is important to examine the connection between citizen empowerment and STEAM practices, as these two concepts are closely intertwined. By integrating science, technology, engineering, arts, and mathematics, STEAM education offers a more comprehensive understanding of the world and fosters creativity, innovation, and problem-solving (Aguilera & Ortiz-Revilla, 2021).

By the reflections put in place so far, becomes clearer the need for a transformative approach, that becomes therefore necessary to challenge future people's assumptions and values and to ultimately inspire future citizens – whether they would become designers or not – to advocate for a sustainable and inclusive change. The following paragraphs introduce an exemplary case study of a program that could possibly lead to a deeper understanding in the creation of effective STEAM educational models. This case study exemplifies diverse STEAM education methodologies employing design principles to instruct students in the practical application of novel technologies and "modus operandi". The following paragraph presents the structure and the results of the series of workshops, designed by Sapienza Design Research at the Punto Luce in Ostia, in collaboration with Save the Children Italy and the Social Cooperative SS Pietro e Paolo.

4. Design for Children Case Study

In line with the objectives of the project, namely those of promoting a center with a high educational density, open to children and adolescents between 13 and 17 years old, where they can find opportunities for growth, development and experimentation through free access to activities ludic-recreational and training, the proposal of the Sapienza Design Research foster cultural, recreational and planning activities carried out with an educational and inclusive approach, capable of stimulating creativity. The initiative promotes the creation

of eight workshops that applied diverse structures to implement a complete STEAM education approach. In this sense, each workshop has been focused on different practices, technology, and context of application.

The eight workshops designed and tailored for this initiative stand out for their use of various technologies and applications guided by Design methodologies, practices through the application of those enabling technologies. The objective of this initiative, entitled "*Design at Punto Luce delle Arti di Ostia*" (Figure 1) was to highlight the capabilities of Design in producing social value by building strategic alliances with the Third Sector, to initiate processes of social inclusion in the most disadvantaged suburbs.

The program designed eight workshops related to the following areas of Design:

1. 3D modeling and rapid prototyping for jewelry design;
2. Dynamic Modeling;
3. Graphics for stop-motion;
4. Screen-printing Design;
5. Small Robot Design;
6. Art in 3D;
7. Comic Gadget Design;
8. Design for Cosmetics.

All those didactic activities involved diverse figures of the University among professors, researchers, PhD students which have worked side by side with local social operators and experts specifically invited for each activity. Over 250 students aged between 10 and 19 participated in the workshop activities organized by the project, which also involved professionals and local businesses that contributed to the development of the activities.

Figure 1. Kickoff day at the Punto Luce delle Arti di Ostia that introduced the workshops to the future students.

4.2 Design at Punto Luce delle Arti di Ostia

The following paragraphs are dedicated to the results of the aforementioned activities, with particular attention paid to the knowledge produced and the skill acquired by its participants. Each workshop is introduced by its structure of activities, followed by a small discussion on the skill developed by its participants and the impact this experience could have on the perception of the potential application of the technology.

3D Modeling and Rapid Prototyping for Jewelry Design

During the workshop, students were introduced simultaneously to CAD design, along with basic jewelry design techniques, while guided through a hands-on approach on the manufacturing process. Each lesson focused on a specific modeling process aimed solely at creating a finished model ready for the printing stage via a filament 3D printer.

Lessons were structured around various daily exercises that continuously produce different product such as rings, pendants, chains, bracelets, with a particular attention to the narrative of the products, which were aimed at communicating the territorial values of their territory or perceptions. Based on previous exercise, the last two sessions have been dedicated to their own designed jewel.

The entire structure of the course saw three main phases distributed in each session of 4 hours:

- The first phase was solely dedicated at introducing jewelry design principles (like ergonomical aspects, touching points, materiality) along with the narratives of formal choices (symbolism and aesthetical aspects).
- The second phase was straight to the practice, through a first rough and fast model on *Tinkercad*, where different shapes, related to the concept intended to be developed, were thrown on the digital scene to "assembly" the jewel. The main 3D modelling program was also used along with other free addon such as *3D2litophane* or *image2svg* to also implement a comprehensive customization of the designs. Once the elements were selected, they were assembled and optimized for the next 3D printing phase.
- The last phase was manufacturing, in which all the models were collected and ordered by the time required to be printed, to retrieve as many models as possible on the spot. In this way every day each student was able to retrieve its product immediately, giving a certain amount of satisfaction and confidence with the theory through a direct result of the practice.

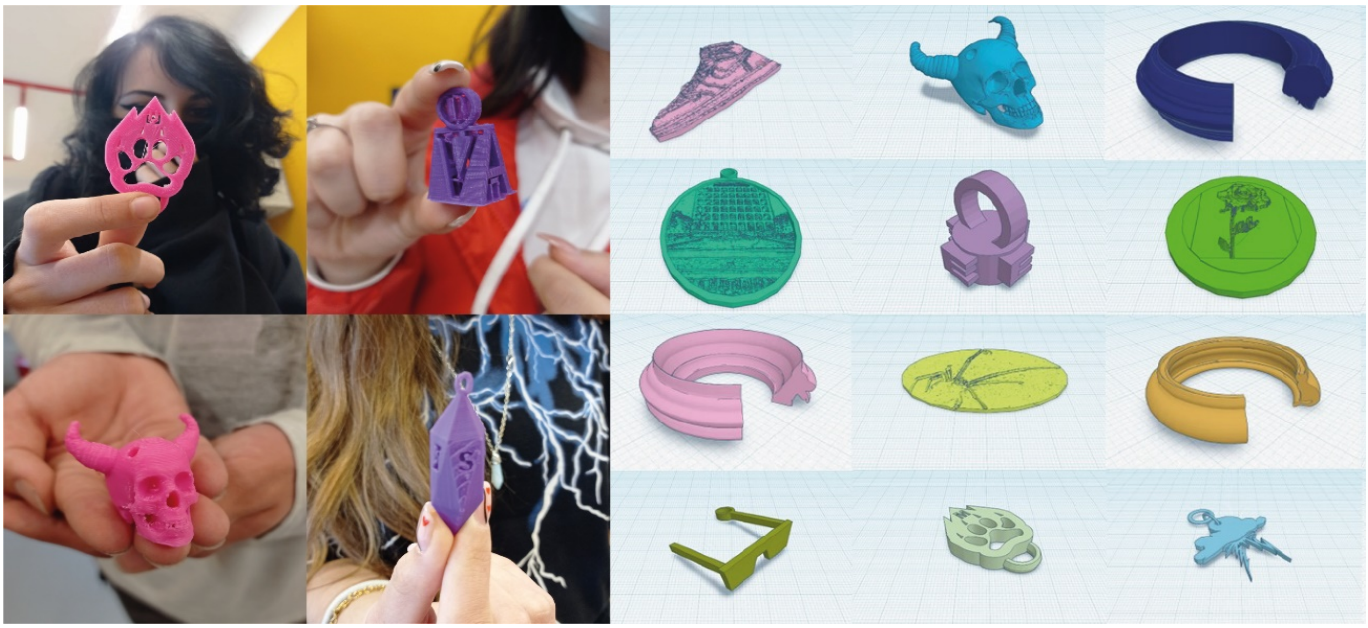

Figure 2. Some of the projects designed by the students and its digital models realized during jewelry design workshop.

Throughout the course, participants gained expertise in 3D modeling, printing, and jewelry design, understanding the intricate relationship between products and bodies (Figure 2). They honed their design sensibilities, grasping principles of form, function, balance, and proportion. Through this, they explored how design choices affect wearability and usability. The integration of diverse disciplines—art, technology, engineering, and fashion—fostered an interdisciplinary approach, resulting in fashionable yet functional products.

Dynamic Modelling

The course aimed at designing and creating a dynamic model using rapid prototyping printers was adapted to the participants' prerequisites through reorganization into two phases:

- The first part involved students acquiring basic knowledge of sailing navigation principles and designing the customization of boat models.
- The second part focused on the creation of 4 sailboat models. Mechanisms for remote control of dynamic parts were installed, and customization was achieved through the creation of masks using vector graphics software, either in vinyl with a cutting plotter or with laser cutting and spray paint.

Figure 3. Picture of the models built and customized during the Dynamic Modelling workshop.

Conversely to other workshops, this course introduced students to the principles of dynamic mechanics, subsequently transitioning to a tuning phase conducive to customization (Figure 3). Furthermore, students were afforded the opportunity to delve into the principles of remote-controlled manipulation, thereby fostering enhanced proficiency in long-range 'hand-eye' coordination processes.

Graphics for Stop-Motion

The course was structured to introduce and guide students through its assembly technique. After an initial historical introduction, the course technically analyzed the differences between video and photography, positioning stop motion graphics between these two mediums. The workshop has been structured as such:

- The first step of the process approached the scripting part, where students imagined and wrote a small story to be told through stop motion, envisioning their characters, settings, and props. In this phase, participants were introduced by professionals to the concept of storytelling, in which they were invited to first describe a story (verbally) and then to reproduce every visual element they were able to seek in the story. Each element was listed and stored as potential "prop" of the scene.

- Secondly, students summarized the fundamental scenes of each story, creating a storyboard that visually shaped the scene. From the analysis of these scenes, each scene has been manually animated, acting as much on the character as the environment props made by hand with colored cardboard and improvised tools. A small photo set was created to capture individual scenes depicted in the storyboard, which have been later-on assembled through free online programs.

Creating narratives and storyboards stemmed advanced understanding for the young participant in developing critical thinking on the touching points of a narrative arc. In this sense, "crafting" their own narratives could ultimately help children to effectively communicate their ideas and thoughts by structuring it logically and conveying them clearly to others (Figure 4). Character and interaction design taught fundamental concepts for understanding the significance of actions, fostering empathy by considering diverse perspectives, while narrative structure analysis encouraged critical thinking about cause and effect, character development, and thematic elements. Ultimately, participants learned to identify patterns and comprehend how various story components contribute to the overall narrative.

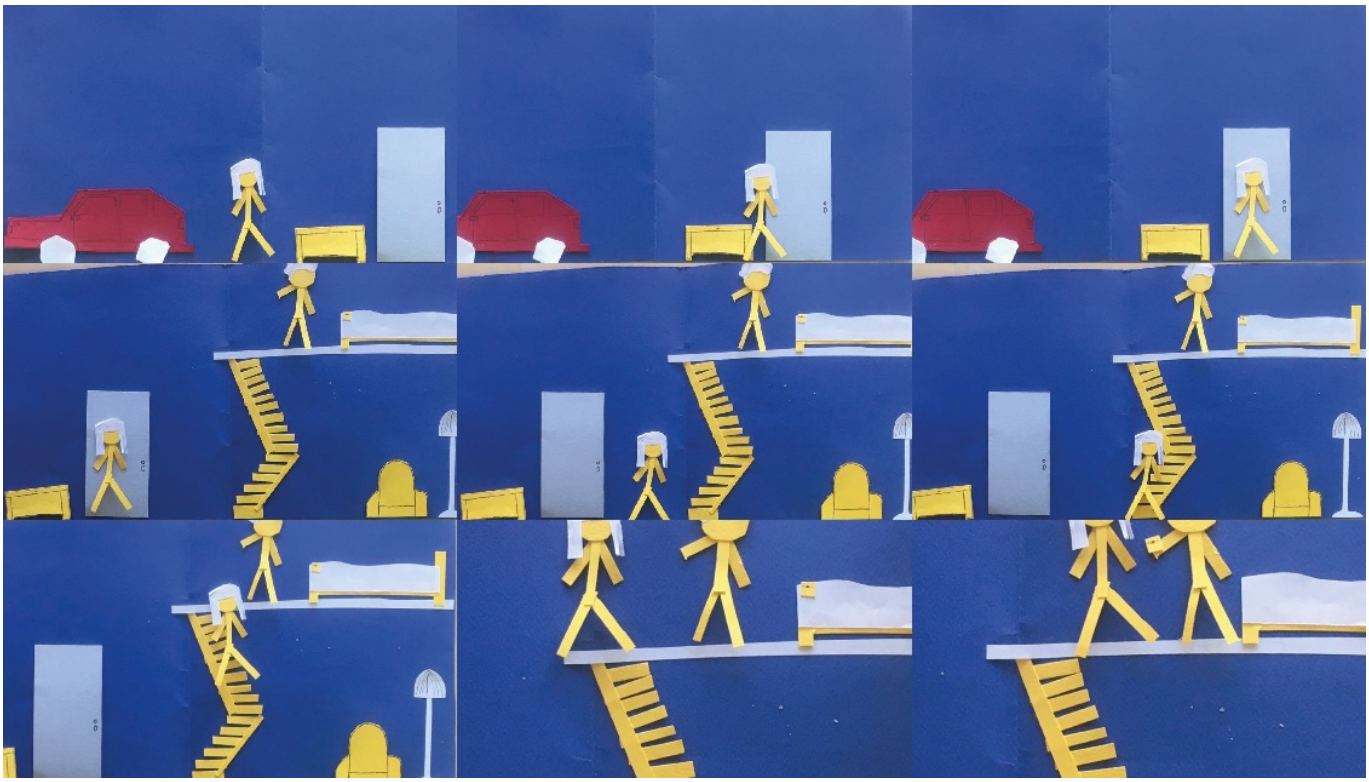

Figure 4. One of the novels represented by the "set" designed by the students during the stop-motion workshop.

Screen-Printing Design

The course aimed at creating screen prints on fabrics and was organized through learning phases, including the history of the screen-printing technique. A common project was identified to create the frame, engrave, and finally print. In its development and adaptation to the encountered context, the course was structured into two main phases:

- The first part involved a theoretical component of screen printing related to designs graphics that each participant wanted to reproduce. Each drawing was then to match the necessary characteristics to be transferred onto a screen-printing frame (by defining shar edges and small details).

Figure 5. The process of silk-screen printing was carried out with the students and some of the results of the workshop.

- The second part focused on the creation of the frames, which were then refined through engraving. Each step involved all the necessary phases of the screen-printing frame creation process, from reproduction on paper to the final exposed fabrics. Approximately 18 students aged between 12 and 16 participated in the course.

Participants have acquired practical manual skills, further deepening their understanding of the serial production process of t-shirts (Figure 5). Moreover, the developed drawing techniques have instilled an initial seed for the development of creative manual dexterity, encompassing drawing skills and selective analysis of the compositional elements of an artwork.

Small Robot Design

The course introduced students to computational thinking and related design, considering the growing impact of artificial intelligence on technical-economic development in various sectors, teaching them to master both the autonomous behaviours of digital systems and the programming of intelligent physical products. The course adopted a simplified model of a two-wheeled robot controlled, equipped with additional sensors and actuators. The course has seen Three main phases along its eight appointments:

- In the first phase the participants were introduced to the computational thinking and coding language through analogue exercises and the use of a development environment called *Makeblock*.
- After assembling the components and becoming familiar with the fundamental concepts of programming for robotics, participants focused on programming behaviours such as drawing on a horizontal whiteboard, creating repetitive patterns, managing input from sensors, and interacting with other robots for a competition.
- The course ended with a small tournament where participants could test the capabilities of their programmed robots.

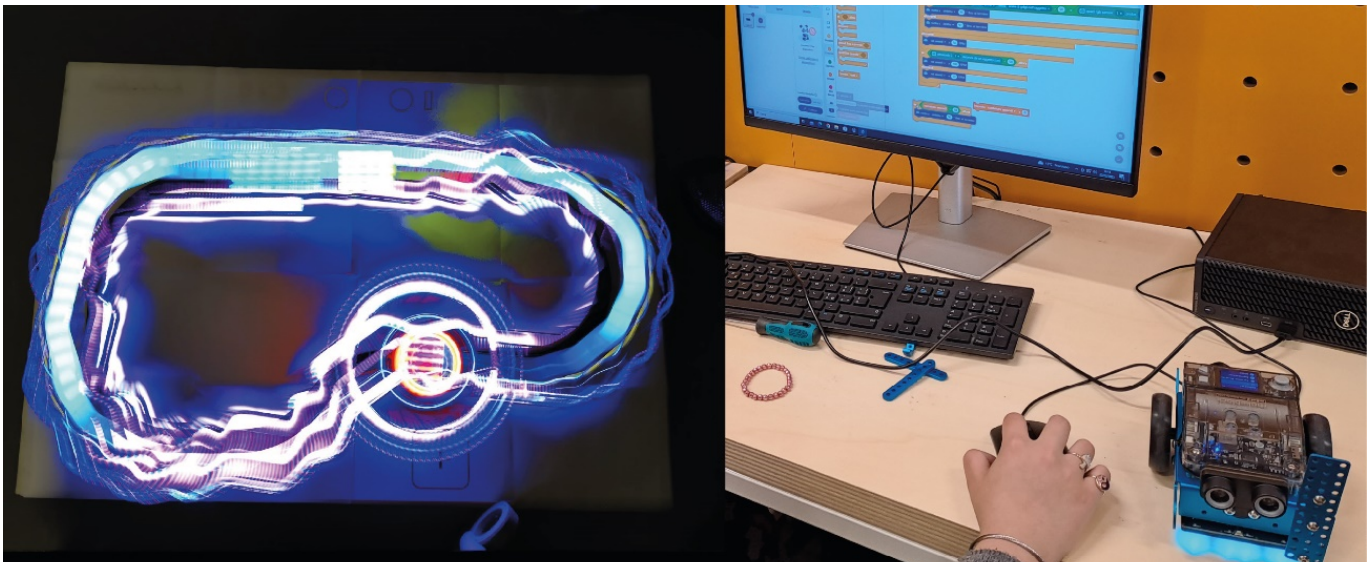

Figure 6. A light effect made to define the path of the robots programmed by the students and the program used to program the small robot.

Through hands-on robotics (Figure 6), children have been able to acknowledge and develop engineering and advanced design skills. While STEAM approach considers computational thinking and coding activities as crucial for children's skill development, the course has instilled in its young participants the ability to identify the basic logic of commonly used electronic products and the ability to perceive the communication patterns of automated processes. Additionally, the course enabled young participants to explore new forms of expression and representation such as light painting and pattern design. Similarly, it opened up to the development of new skills and the possibility to redesign (rather than reprogram) specific behaviours previously considered "preset" and inaccessible.

Art in 3D

The workshop of *Art in 3D* has been designed to let students approach to history of art through the analysis and to then digital redesign it of paintings using 3D modelling software. The course was divided into two phases:

- In the first phase, participants learned to use digital tools and fabrication by working together on a historical art masterpiece (such as *Piazza d'Italia*, 1948, by Giorgio de Chirico).
- In the second phase, the students developed critical observation and individual creative expression, repeating the exercise previously tackled collectively, but this time referring to abstract art pieces and increasing compositional complexity.

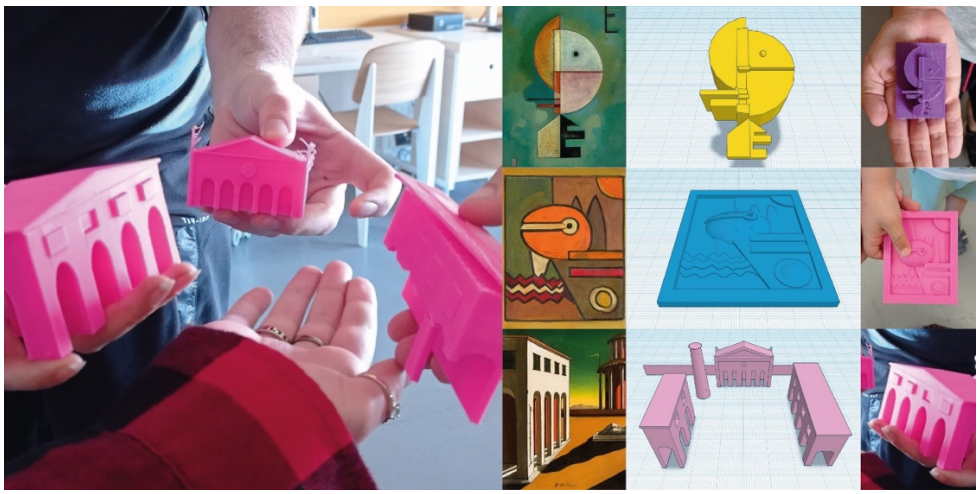

Figure 7. Some of the art pieces that were designed and printed by the students during the *Art in 3D* workshop.

In both phases, the painting was introduced through a short documentary on the artist's poetics and then reproduced in 3D. Here, greater emphasis was placed on individual creativity and problem-solving approaches, creating spaces for peer education. The characteristics of the suggested artists and Paul Klee's specific poetic of layering were discussed and provided the basis for the creation of new 3D interpretations by the participants. The resulting works, that were finally 3D printed (Figure 7), enable students to engage the original artwork from different perspectives, stimulating a process of "active reading" that enhance, above creativity, a sense of critical thinking and analysing skills towards the existing scenarios.

Comic Gadget Design

The workshop was structured with the aim of creating 3D-printed gadgets of hand-drawn characters, covering design, 2D graphics, 3D modelling, and 3D printing. In a very straight forward structure, the workshop consisted of three sessions, organized as:

- In this initial phase, participants engaged in the creative process of drawing their characters. This step involved short sessions of brainstorming, sketching, and refining ideas to create compelling designs. Participants adopted traditional drawing activity (through a piece of paper and a pencil) in which the only requirement was to keep an heavy stroke of the trace.
- In the second phase, participants started the digital design and 3D modelling. They made use of the usual *Tinkercad* software to transfer their 2D drawings and translate them into three-dimensional digital models, adding depth, volume, and eventual details to their characters. This phase involves learning the basics of 3D modelling and applying them to their designs. Lastly, the designs were applied on a plan keyholder 3D model to give final portability and functionality to the design.
- In the third phase, the designs were 3D printed. Participants learned about the process of setting up 3D models for printing, including considerations like scale, orientation, and support structures.

Figure 8. Students during the design process and an example of the final outcome of the printing process.

The structure of the workshop was linear and progressive, with each phase building upon the work completed in the previous one. By dividing the workshop into distinct phases, participants focused on specific skills and tasks related to each stage of the design and production process. Additionally, this structured approach allows for clear learning objectives and facilitates a logical progression of knowledge and skills acquisition throughout the workshop.

Through various phases of analysis, development, and production, young artists navigated through the world of reproducing and revisiting plan graphic designs into 3D models (Figure 8). During the course, the main 3D printing technologies were explained, along with materials, techniques, and common issues. Participants also learned the basics of three-dimensional modelling, applying them to the creation of customized keychains using their own drawings, which were first hand-drawn on paper and then digitized and converted into vector format for modelling.

Design for Cosmetics

The laboratory focused on the use of digital technologies for modelling and prototyping, aiming to create 3D printed prototypes of moulds for the casting and compression of solid detergents. Through various phases of theoretical study and practical exercises, a series of prototyping was carried out using moulds made with additive manufacturing, followed by considerations on the efficiency of the mould and its improvement through the optimization of shape, material, and process. The workshop has been structured on 5 sessions of 3 hours each one:

- The first two sessions have been dedicated to the acknowledgment of the material, like its density, and malleability. Along with a design thinking approach, students have been also introduced to evaluate the stimulus they could retrieve from the sensorial features of the material such as the smell or the colour: this phase introduced the students into a first phase of sense making in design.
- This step involves the practical application of technology (3D printing) to create moulds. Participants gained technical skills related to digital fabrication and mould-making during this phase as well as they have been introduced to practical mechanical issues of moulding process (like the most common undercut issues). This part was particularly sensible since was the critical part in which participant started to develop problem-solving skills to intercept and resolve possible issues in the opening of the mould. Moreover, conversely to the previous workshops, in this phase participants were asked to model the final shape of the soap to perceive the potential result, but then were required to subtract the latter to the mould to have the proper tool. So, they have been also guided to think at their shape as the negative of their actual print.
- In the final step participants used the printed moulds to produce the final shape of the soap. It involves applying their understanding of the material and the design thinking principles to create a tangible product.

Figure 9. Examples of final soap resulted by the moulding process and other designed digital models.

Despite the complexity of the subject, which required young participants to think of their design as the master for a mould, the participants were particularly engaged in the process, especially in customization phase, actively participating, generating, and achieving excellent results (Figure 9). Moreover, since the continues practical activities carried out along with the participants, the entire course has been able to adapt the activity based on the response retrieved by the participants and the technical requirements of the cooperative and the technical consultant. Lastly, the emphasis on sense-making participants interpreted and understood information by evaluating sensorial features like smell and colour, opening to a more comprehensive approach to design. This enhanced their ability to create products that engage users on multiple sensory levels.

5. Discussions

The project has had significant impacts on various aspects, which can be framed within fundamental aspects for territorial development and social fabric. In particular, the impacts of this project have had repercussions analysed concerning the territorial scope, specifically looking at the development of new awareness and social empowerment for the young beneficiaries. Furthermore, consideration is given to the economic, social, and cultural dimension of the structure itself that hosted the courses and the positive impacts for the educational staff, as well as the enhancement of the identity and reputation of the initiative gathered within the spaces. The overall project outcomes and impacts have been evaluated based on the following factors: 1) Educational Scopes, 2) Users Engagement and Involvement, 3) Local Cultural Development.

Educational Scopes

The eight creative workshops were characterized by activities that included the use of both manual arts such as screen printing and dynamic modelling, and digital ones such as 3D modelling, programming for robotics, and animation.

This diversification has allowed the development of specific skills, aiming to provide the Punto Luce with the ability to offer students advanced training in the context of project culture and new manufacturing technologies. The close collaboration with Save the Children Italy and the partner Social Cooperative SS Pietro e Paolo has therefore extended the social and territorial impact to the entire neighbourhood, involving profiles at risk of social exclusion from different municipal areas.

Users Engagement and Involvement

Main beneficiaries of the project were youths aged 12 to 19, including secondary school students, young people with learning disorders, those from families at risk of social exclusion, and NEETs (Not in Education, Employment, or Training). With regards to those more sensible citizens, the laboratory activities have contributed to social inclusion, countered educational and material poverty, and facilitated the orientation and integration of young people into the workforce. Collaboration with the University has also allowed beneficiaries to come into direct contact with the academic institution, opening prospects for educational growth. The project enabled students to approach new manufacturing technologies and programs for 3D modelling and robotic programming, taking an important first step towards learning both technological tools and thinking. Furthermore, the entire project pathway involved various actors, professionals, and local stakeholders who are nowadays continuing their participation in the project by contributing to the teaching and the sponsorship of the Punto Luce, as well as by participating at the dissemination of the project's results.

Notably, the overall project has ultimately increased the number of enrolments in the extracurricular courses offered by the Punto Luce delle Arti in Ostia, offering inclusive and highly relevant teaching in the acquisition of practical knowledge regarding new technologies.

Local Cultural Development

From a social and cultural perspective, the project has addressed the educational poverty of the Ostia Ponente area, becoming a reference point for local cultural development. Collaboration with the Social Cooperative SS Pietro e Paolo has introduced a project for creating jobs dedicated to individuals at risk of social exclusion at the city level. The project expanded its impact area through the organization of events, including an exhibition of the course results and the open conference "Design and Third Sector: Stories and Perspectives", which gathered testimonies and reflections from various actors in the world of scientific research, institutions, professions, businesses, and civil society. The event also hosted a workshop open to very young students from the Ostia neighbourhood hosted at the Save the Childrens headquarters.

Furthermore, the project considered an important temporal component in imagining the impact that such activities could have on the territory and specifically on the economic aspects of the Punto Luce space: it aimed both at the training of the very young, introducing them to the world of design and its rudiments, and at the enhancement of the internal staff of the space. The staff of the Punto Luce delle Arti in Ostia was therefore adequately updated and trained in the use of the tools necessary for the courses (robotics, 3D modelling and printing), which they could then integrate confidently and autonomously into their spaces. The results of the courses are also exhibited in an exhibition that, in addition to arousing the interest of students and young visitors, proudly represents the work that motivates young designers to offer themselves for mentoring programs to new members, thus promoting the knowledge production chain.

6. Conclusions

The research and experimentation activities applied during the workshops have brought out from the Capitoline social fabric a latent planning of the communities and new design spaces which, together with the theme of social inclusion and the active role of the citizen, are issues addressed marginally by the Public Administration when it comes to social innovation (Balbo, 2015). In this open scenario, design can operate to reveal the needs and will of the community, transforming them into possible solutions of public utility.

The result of the project has been ultimately exposed for at the Sapienza Faculty of Architecture in Valle Giulia (Figure 10). This project has been also selected as part of a dynamic observatory, launched during the national event *Design & Terzo Settore. Storie e Prospettive* (Design & Third Sector. Stories and Perspectives) in which occasion a final workshop has been setup to let participant of 8/10 years old discover the University and the design practices.

Figure 10. Exposition of final works at Exposition Gallery of the Sapienza Architecture Faculty in Valle Giulia.

The project and its outcomes highlight the role of Design Research in connecting Universities, citizens, and municipalities in applying design knowledge and principles to real contexts (Meyer & Norman, 2020). This research explored a built environment made of both physical and digital products that acknowledge the cultural richness stemming from the ethnic, cultural, social diversity present in cosmopolitan cities such as

Rome. The project provides in last instance, an overview of an emerging and ever-evolving alternative scenario which entangles on a global scale, and which ultimately could work as a means for further actions and research towards Design-driven education for social innovation and citizen empowerment.

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