Children's Reflection in Action with DIY

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ABSTRACT

The present case study describes and comments on an experimental activity with 9-11 year old children of a public school in Lecce (Italy) in August 2018. The pupils were required to create computational tools using materials recycled from their own home. We adopted a constructionist perspective; we wanted to foster reflection and discussion among the young participants on the amount of household waste produced and how it can be repurposed for creating novel objects. In order to achieve our scope, we were guided by collapse informatics theory and research through design.

CCS CONCEPTS

• **Human-centered computing → Field Studies, Participatory design**

KEYWORDS: Collapse Informatics, DIY, children, making, research through design, participatory design, constructionism.

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Figure 1: Children during the activity.

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1 INTRODUCTION

Recently, in HCI there has been an increased array of new approaches looking towards criticality, narration and reflection about the future (summarized in [12]). Some of those intents focus on raising awareness about the potentially negative consequences of the continuous and indiscriminate development. For example, collapse informatics (e.g. [20, 21]) concentrates on how the effects of our present decisions can impact on the next decades in terms of lifestyle. There is a partial overlapping between designing for a future of scarcity and critical design [3] in terms of playfully engaging with negative thoughts in order to manage them through diegetic artefacts [18] and share them (e.g. [9]) for fostering speculation and discussion. Criticality and reflection in action are also materialized by means of practices that represent ways in which some anxieties regarding the incoming future are concretized through sustainable practices [21]. In this case study, we present an activity with 20 children aimed at suggesting them the importance of raw materials and the feeling of satisfaction when doing a thing by themselves whilst recycling an object that would otherwise be thrown out. In a nutshell, we intended to stimulate them to think about the future in relation to their present choices and consider the value of recycling. Before describing the activity, we will present collapse informatics and research through design as well-grounded approaches in HCI that have guided us in the preparation, execution and analysis of the activity with the children.

2 BACKGROUND

2.1 Collapse Informatics

Collapse, as it is predicted by the archeologist Joseph Tainter [20], is a rapid loss of complexity in a sociocultural system due to imbalanced economic, political and social choices. In this case, mentioning collapse starts with the historical analyses of Jared Diamond [7], in which the causes of past populations' disappearance are described, evaluated and compared with present civilized economic, political and social systems. At present, there are reflective practices (described in, e.g., [21]) that incorporate hypothetical solutions to this problem. An example of those behaviors is the Do-It-Yourself (DIY) culture (e.g. [17]). DIY is an appropriation of discarded materials aiming at adapting them to novel contexts. Customization, creativity, repurposing, and design-in-use are some processes involved in the DIY practices whereas configurability, visibility, subversion, openness, interpretation and intentionality are other properties of those objects [8].

Figure 2: Children involved in tinkering activities using recycled materials.

Those renewed objects tell the story of their past "life" and engage the user into a new history in which function, material qualities, aesthetic pleasure and interpretation are joined together into new artefacts [13]. This process is called domestication [8] and it is about the ability of those new objects to modify the environments they are located in and to inspire a sense of ownership and affection.

2.2 Research through design, diegetic artefacts and design fictions

Besides the uncomfortable dreams of critical design [9], there are other approaches more suitable to the innate playful predisposition of children. For example, research through design [24] uses design methods in order to explore, code, understand and present problem spaces. This disciplined imagination, can fix the constraints, manipulate the elements at stake, or create novel combinations that help to see the situation from a different perspective. A type of research through design is the design where the artefact itself is telling its own story which describes an imaginary tomorrow and through which it delivers values and reflections about potential scenarios [16]. Design fictions can be placed between design practices and narrative explorations and are aimed at creating stories that manipulate meanings regarding possible future alternatives [16]. In our case study, we used material speculation in particular [23], in which fiction is incorporated into physical artifacts, therefore assuming a diegetic tone. Thus, the obtained prototypes hinted towards a world of imagination, one in which they are functioning, and which is explained and concretized through the narrative qualities of the designed objects. Those artefacts are diegetic in the sense that they tell stories placed between the actual, the possible and the imaginary. They set up the contexts and conditions in which they take place and they create the setting for moving back and forth between the present and the future, therefore anticipating discussion about ethics, values, and implications in a playful way. In the following paragraph, the other components of diegetic artefacts used during our activity are described, that is, children's materialization of their thoughts through physical making of actual practices.

2.3 A survey on children's making

Children's making plays a relevant part in the teaching curricula. Tinkering, in particular, is appreciated for its capacity to trigger imagination, exploration, desires, and free thinking. On this point, we used tinkering with recycled materials in order to develop environmental consciousness and an ecological concern. The exploration of materials and the free manual dialogue with them [15], have important roots in the past of educational theory. Children's manual crafting for the purpose of learning has, in fact, its roots in the past century work of well-known pedagogues, such as Montessori, Piaget and Freire [5, 6]. Accordingly, the seminal research in the MIT Media Lab has provided both theoretical frameworks and methodologies for digital fabrication [5, 6]. The MIT's constructionism [14], is in fact the most relevant learning approach that focuses on increasingly scaling, or expanding the existing knowledge of the child.

Figure 3: A child designing a robot.

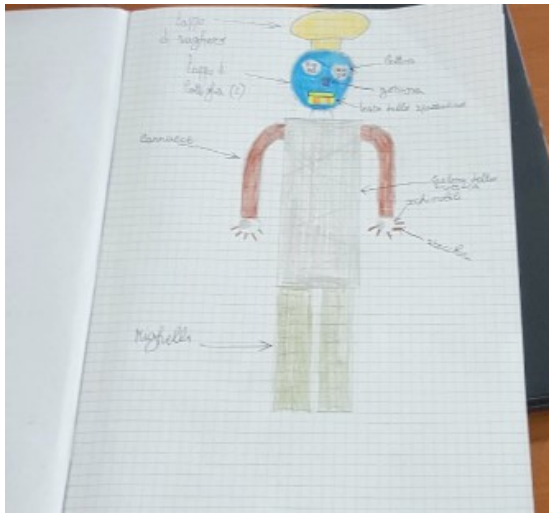

Figure 4: The design of a robot after the brainstorming phase.

According to constructionism [14], learning processes look more like progressively building with bricks rather than filling up a vase. By physically engaging with tools and sharing them with their peers, children comprehend the activity on their own and develop or improve existing mental structures. The collective tinkering with materials and objects creates a distributed knowledge that is to be found both in the external world and, just like reflected in a mirror, in the inner cognition of the child [22]. Therefore, the external activity determines an expansive articulation of the internal mental structure in agreement with what happens on the outside [14]. The HCI community has been paying close attention to children's making culture by dedicating it workshops [5], annual conferences [1] and reviews [11]. Design thinking, starting from the beginning of this century, has been evolving toward embracing topics of ethical and social stances [19]. This paper can be considered a step forward towards providing sustainable growth activities for children's creativity a new topic by means of research through design (see previous section) and aiming at creating a connection between the (external) dialogue with the discarded materials and the (internal) development of environmental awareness.

3 THE ACTIVITY

The activity was carried out with primary school children to promote their reflection on environmental sustainability by using recycled materials and computational components (Fig.1). The activity was funded by the Department for the Equal Opportunities of Italian Government to increase children's skills in Science, Technology, Engineering and Mathematics (STEM) and was carried out during a summer school (40 hours) with 20 children (9-11 years old). Each child brought some domestic waste (milk carton, empty bottles, etc.) and shared it with their peers (Figure 2); using this approach, the children could reflect on the large amount of waste produced daily at home, on how widespread the use of plastic is , on how the produced waste can be reused by others and above all on how many other purposes it can be used for. Firstly, children had a brainstorming activity into groups. Secondly, they designed their own robot defining the functions, specifications, shape and what recycling materials could be used for (plastic, cardboard, electronic pieces, etc.) (Figure 3 and 4). Lastly, they built a robot with chosen recycled materials (Figure 5).

They used not only paper, plastic, and other household waste, but also individual parts from old electronic boards and broken cell phones that they disassembled. The proposed tinkering activity allowed the children to design robots that meet environmental sustainability needs, namely a robot that autonomously cleans waste off roads, a drone that washes, collects waste and empties garbage bins, or a waste bin with sensors that permits easy access to differently abled people. Once the model of the robot was made, each child reflected on what made an object "smart", what computational power was, and how to structure actions in algorithms and instructions. To experiment with these aspects, technological kits were used (Lego WeDo 2.0) that allowed the young ones to move Lego objects according to the instructions provided in the appropriate software (Lego or Scratch software).

Figure 5: A robot built by child from household waste.

These software packages have a block programming language base that allows children to develop computational thinking through coding activities. Moreover, constructionism and making activities require interventions not only for using educational technologies, but also for properly setting up the physical spaces, which must be centered around the student itself. The classroom arrangement, in fact, affects the children's cognitive processes and facilitates learning experiences and ideas. During the activities carried out, the teaching and training settings have been modified in relation to the performed activities, favoring the grouped-desk arrangements for collaborative work and DIY activities and a circle-desk arrangement for brainstorming and for the presentation work. This allowed us to modify the concept of a traditional classroom setting and introduce a "laboratory for ideas" concept, a multifunctional and operational area which facilitated the children's learning and knowledge creation. This shift in the perception and the perspective was due to the fact that the students were active participants in the carried out activities. For these reasons, such a space dedicated to making things inside a learning facility is strongly recommended.

4 THE CHILDREN'S FEEDBACK

During the activity, children were amazed by the quantity of waste they had collected so they reflected on how their wastes can be reused for other purposes. They were very satisfied with their prototypes and anxious to describe them to their parents. We also collected pupils' opinions and reflections both during and after the course by asking them to fill in a questionnaire. Overall, the quantitative analysis shows that they liked the activity, they did not find it difficult, they did not perceived it as strange and that is was interesting. The qualitative analysis of the questionnaire shows some recurrent opinions among the students. The first aspect most of the children referred to when being asked to describe their robot, was a description of the recycled materials they used:

I used small boxes, plastic bottles, thin canes, bottle cups and buttons. (N05)

The children's stress upon the components of the robots show their interest in the materials used.

This in turn puts in evidence how the children undertook a manual dialogue with the discarded materials and carried on a reflection in action about the practice of recycling. This is also remarkable when they were asked for their opinion about recycling:

I think recycling is better than throwing out. (N02) To me recycling is important because it helps the environment (N11). To recycle material is useful for the cities of tomorrow and also for saving trees, oil, or gasoline (N18).

The feedback gotten from the children highlighted that the practice of recycling incorporates consciousness in terms of environmental concern and active citizenship. Therefore, this awareness is twofold both in the fields of abstract reasoning and in those of practice.

From the phrases and sentences used by the children, it emerges that this internalization process was encouraged by tinkering as a creative, social activity, and, as a consequence, it became an internal thought [22].

5 LESSON LEARNED

We wanted the children to carry out a reflection through design, by means of a practical activity [16, 23]. We have achieved two objectives: to make the children understand the functioning of a simple circuit and, knowing how to reproduce and use their knowledge and skills, to have them build something unique and creative. Designing the robot was perceived as a game, but it, actually, is more than that, it becomes an environment and a learning context since the final aim is not the acquisition of basic scholastic skills, but an autonomous cognitive functioning, i.e. a correct orientation in space and time. On the one hand, the children have acquired skills on the topic of environmental sustainability, on the importance of recycling and how to correctly manage waste; on the other hand, they have gained additional skills in dealing with new problems, working while having a at project in mind and connecting hypotheses and solutions.

Looking back at our activity from the initial premises, we realized we elicited their reflection in a playful setting, by making them think of the possible future consequences of present actions toward waste management. Their diegetic prototypes [18] were telling stories about sustainability while reusing household waste, therefore they used the design activity as a tool supporting imagination, knowledge, reasoning and interpretation. In this respect, their visual and tactile dialogue with the recycled materials represented a reflection-in-action [15], taking chances on objects' physicality, fascination and other specific features that made them realize the potential value of waste and the importance of making a good use of it. This activity, in turns, introduced the children to the DIY culture that is weaved in the thread of collapse informatics. Children were involved in the reconfiguration of discarded objects that acquired novel meanings when being differently assembled and repurposed. This, in turn, can be considered not only a creative work but an activity that can also bring specific traits of intentionality.

Consequently, the adaptation to novel contexts of turning discarded materials into new tools also allowed their creators to engage in an affectionate relationship with them, by feelings of ownership and aesthetic pleasure. In addition, this change in meaning represents overcoming the politics of planned obsolescence and of the culture of the disposable, which are, as well, important tenets of collapse informatics.

4 CONCLUSIONS

Children making DIY with the purpose of reflecting around sustainability is an assertive activity in which they reason about their own future and about the world which the adult generation altered with their present behaviors and which would be their heritage. The described activity with the children refers to two main areas of HCI, that are research through design and participatory design [10, 11]. We provided tools and procedures for inspiring children to critically analyze the present and the future times based on the current activity of waste management. We chose a tinkering activity because it is an informal learning methodology that encourages experimentation, teamwork and cooperative learning. By exploiting creativity, manual skills and curiosity, students were able to develop some skills that are fundamental for the contemporary world, such as critical thinking, the ability to innovate, learn to learn and to increase their aptitude for lifelong learning, too. DIY activities allow to enrich the training programs with the acquisition of soft skills (communication and teamwork skills, problem solving and design thinking) and life skills (citizen identity), as in the illustrated case study. This consisted not only in having the children invent new alternative technologies, but also in giving them positive conditions and a suitable space in which they can create and develop reflections on technology. We made this possible by challenging the current situation (the abundance of waste) and revealing alternatives (making something useful with it). At the same time, we helped the children develop skills like design thinking, reflecting on the future consequences of current behavior, reasoning about technologies (and their possible applications in the daily life), civic engagement and the development of ethical reasoning about the current situation.

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