Children's Tinkering Activity with Collapse Informatics: The Internalization of Environmental Consciousness

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Abstract. In the present paper we introduce an activity involving twenty elementary school children aimed at increasing their awareness towards the importance of reusing waste materials. Once that target is achieved, we facilitate children's purposeful construction of diegetic artefacts and imaginary robots that have environmental purposes. The main goal of the activity is to engage children in tasks through which they begin to reflect on their own future and in particular on how the current choices of the adults can influence the future of their world. The principles of collapse informatics and research through design are the basic key concepts of this project.

Keywords: Tinkering · Collapse informatics · Freire · Constructivism · Research through design

1 Introduction

What kind of world are we leaving to future generations? How does our present behaviour affect their future? Reflecting on the possible scenarios triggered by our legacy has been a recurring topic in the field of HCI (e.g. [15]). In particular, the theoretical thread of collapse informatics (e.g. [25, 26]), which draws inspiration from Jared Diamond's historical analysis what we know about of ancient societies and tries to explain their actions that led to their disappearance; massive deforestation, over-exploitation of the natural resources, soil erosion, or overpopulation are among the most relevant hypotheses [9]. In HCI, worries, anxieties and (uncomfortable) dreams have already been dealt with by Research Through Design [28], where the creation of artefacts represents the embodiment of thoughts, concepts, and constructions of prototypes, in order to foster reflection, discussion and sharing. Using dysfunctional, unpleasant, or ambiguous objects, critical design [10] aims to materialize our fear about the future. Critical objects reverberate in our minds through fascination and repulsiveness and stimulate contemplation, analysis and dialogue [11, 12]. For this activity, we found inspiration in the work of the Russian photographer Archipov [2], who describes the crisis of the post-soviet Russia through do-it-yourself (DIY) objects, and the way (impoverished) people creatively solved their daily shortages by assembling waste into useful, new objects. For the analysis part of the activity, we employed the

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constructivist theory [17, 19] and the process of tinkering represent the theoretical framework of the activity, where, manually exploring a problem, various kinds of objects are being made using recycled materials [6], also according to the principles of the Russian psychologist Lev Vygotsky [27] who considered such types of activities useful for expanding children's minds. Just like him, we, too, have found inspiration by the perspective in the 19th century pedagogue Freire's work [13] who used children's intelligence and inventiveness as potential drives for transformation. After completing the activity, we analyzed it in order to understand how children have progressively addressed environmental concerns, as a reflection in terms of social capital [1, 18], starting from the manual dialogue with the materials and culminating with building useful artefacts [20].

2 Collapse Informatics

Over the past years, the concept of collapse has started to become more and more familiar to people as they often hear it in the media (e.g. [9]). A society collapses when it loses economic, environmental, and social resources, thus leading to the excessive poverty of its people [9]. Many important past cultures are described by historians during their greatness, during their road towards collapse, and often all the way to their complete disappearance. The interest to understand why so many social systems have collapsed in the past also helps us to understand the current behaviour of industrialized civilizations, especially those that recklessly exploit our natural resources, pollute, or are overpopulated. As a result of those historical analyses, we can direct our current stance towards sustainable choices that would hopefully prevent us, the humanity, from becoming extinct. The concept of collapse has been adapted to the HCI discipline thus coining the term of collapse informatics (e.g. [25, 26]), which encloses reflective practices that overall challenge societal trends such as mass production, disposable culture, planned obsolescence, and consumerism. This is where the tinkering practices come in handy given that they promote the reuse of waste and its re-semantization into novel contexts and for different uses. Customization, creativity, reuse, and design-in-use are some processes involved in constructivism and DIY practices. Configurability, visibility, subversion, openness, interpretation and intentionality are a few features of those newly built objects [7, 23]. Those new objects tell the story of their past life and engage with the user in a journey in which function, material qualities, aesthetic pleasure, and interpretation are all embodied in new artefacts [16]. This is called the concept of domestication [8] that speaks of the ability of the new objects to modify the environments they are located in and to inspire a sense of ownership and affection in their owner.

3 The Work of Vladimir Archipov

The Russian photographer, Archipov, travelled across post-soviet Russia for 11 years while documenting homemade artefacts [2]. His artistic and anthropological considerations and his views on recycle and reuse are extremely relevant for this paper.

The starting point of his research is the shortage of goods in the post-soviet Russia. We started this project driven by the shortage of resources due to extensive use and mirrored his findings. He shot marvellous homemade objects and gathered information about their building process, thereby representing the private daily life in a country where the lack of goods was a day-to-day problem. DIY, in turn, provided feelings of pride, satisfaction and ownership for the home made artefacts effectiveness and unicity. In fact, even if those objects are far from being perfectly executed like those done by professionals, they represent the transformation of an object into another, transformation which, in itself, is an artistic process. In his photographs, we can find tools for processing food, for taking care of bee hives, for carpentering, for gardening, for fishing, for skiing, for making music, or toys for children to play with. Those objects are often meant to increase the quality of life of their owners, like an antenna made up of forks that helps its owner and creator to catch TV programs. Due to the militarization of the soviet regime, many object were made of materials from military equipment. The DIY culture in his book often comes is rooted in his ancestor's skills to build useful objects for sport, leisure or hobbies that they would not have been able to own otherwise. This usually made people revalue leftover materials, such as plastic, wood, metal and appreciate them for their intrinsic properties, e.g. resistance, malleability, isolating capacity, lightness, transparency, etc. Those objects hold their intelligence and their unicity out from marketing. At the same time, we believe that those objects belong to the field of research through design in that they are diegetic artefacts, objects that tell a story and concretize the imaginary of the person that built them from waste. Following that, there is a brief review of some of the critical stances in HCI that we took inspiration from for our workshop with the children.

4 The Diegetic Artefacts

Collapse informatics, as part of the HCI theory, is a reflective practice aimed at articulating compelling sustainability issues. In this context, reflectivity materializes the design concern unveiling sustainability issues and bringing them to the public attention. Critical reflection takes, indeed, a political stance when designers are asked to focus on everyday practices and deal with prejudiced mindsets that view certain things as garbage and [20] identify alternatives to those practices. Those reflections can be included in the broad category of research through design, too [28] since they uses design methods in order to explore, code, understand, and present problem spaces, facilitating their perception from different perspectives. This is achieved by manipulating the elements involved, creating novel combinations, and providing unusual views on a topic. For example, design fictions [24] have been proposed as unconventional prototypes describing imaginary tomorrows and creating bewilderment toward otherwise familiar topics. This process of defamiliarization is not new to the HCI's theory [3, 5]. Estrangement is a creative method of opening up design spaces by disconnecting from familiar experiences and looking at the usual context with a form of 'disorientation'. In this framework, diegetic artefacts provide the tangible materialization of these feelings. On the one hand, diegetic artefacts are objects on the borderline between literary practice and design that help us to visualize alternative futures. On the other hand, this

activity, should encourage people to reflectively and critically view the present days. Design prototypes incorporate meanings, values, narratives, feelings, threats and it has even poetic aspects, thus, enabling a creative manipulation of the assumptions hidden in the status quo. This way, they physically bring utopias or dystopias to reality while ideologically questioning the present through design practice [11]. In the context of our case studies, we have made particular use of diegetic prototypes, in which fiction is incorporated into physical artefacts, thus assuming a diegetic feature. These prototypes imply the imagined world in which they function, a world that is explained and concretized thanks to the narrative qualities of the designed objects. These artefacts establish the contexts and conditions in which they take place and they create the scenario for moving back and forth between the present and the future, thus, anticipating a playful discussion on ethics, values, and implications. All these paradigms are an important source of inspiration for our work. Another important part of the theory concerns the creative approach towards children and the use of imagination to transmit them values, thoughts and reflections on sustainable design.

5 The Work of Paulo Freire and the Constructivism

The exploration of materials and the free manual dialogue with them [14, 20] have important roots in the past of educational theory. The pedagogical work of Freire, for example, is aimed at presenting an educational framework in which the child actively creates his own existential and cultural growth [13]. In Freire's opinion, knowledge exists only in invention and re-invention, in the restless and permanent questioning of the world and of other people, where the teacher does not fill his pupils with notions but is a facilitator of research processes that lead to discovering those notions themselves. This way, learning takes place during activities of joint re-creation and transformation of the existing realities, in order to make sense of them. This method emphasizes the uniqueness of children through creativity, valuing their humanity and their conscience through an intentional relationship with the world. This problem-based learning becomes a joint activity involving both the pupils and the teacher, in which challenges become a vehicle for critical knowledge and, in turn, an expansion of the mental frameworks. This develops a set of strategies to know the unknown in children that is Freire's main message. The pedagogue believes that education must be more like learning to discover rather than having the contents delivered by the teacher. Thus, pupils are actively involved in their learning processes which is also the main tenet of constructivism and is explained as follows.

5.1 The Constructivism

The term constructivism has its has been built upon Papert's experience of using ICT with children [17, 19] and focuses on the active exploration of a topic, while linking what is being discovered with existing knowledge and experience. Constructivism refers to the constructivist theory of Piaget who considers learning as a reconstruction of knowledge and not just as a simple transmission of that knowledge. Accordingly, the construction and therefore the learning is more effective and mastered when it is not

only mental, but it is supported by a real construction, by an activity such as the building of a meaningful project. Thus, constructivism introduces the construct of cognitive artefacts: objects or devices that support learning as an external framework that allows the internal and correspondent creation of knowledge. These concrete products must be shown, discussed, examined, probed, and shared. Therefore, children develop their own understanding of the world as an active process of building. This way, they autonomously acquire knowledge by expanding their own frameworks. The child becomes the protagonist of learning, while the teacher assumes the role of a facilitator, who should refrain from providing pre-build solutions; he, instead, must try to help the pupils to follow their own paths toward personal, meaningful goals. Another important point is the peers collaboration as a relevant method to interactively achieving shared goals. This particular emphasis on external activities and collective goals is linked to the vygotskian construct of knowledge that stipulates that one should first develop using elements of the outside world and then through inner cognition [27]. An important method for putting these ideas into practice is tinkering, the child's manual, creative exploration of a topic with the final aim of expanding his personal, mental frameworks.

5.2 Tinkering

Children's making of objects is receiving substantial attention in the educational field and gaining more and more weight on its agenda (e.g. [4, 19]). In particular, tinkering is highly valued for its capacity to trigger imagination, exploration tendencies, and critical thinking, whilst allowing children to make mistakes and learn from them. The activity of tinkering implies the free experimentation with raw materials without always having a precise aim in mind and it is directed toward developing a detachment from a consumerist attitude [6]. By manually exploring materials, children take control of their own creative processes, learn to take risks, to come up with rules and, at times, even break them, in order to expand their individuality and their sense of self [6]. Through tinkering, children gradually develop autonomy, freedom and responsibility, which, in turn, allow them to develop feelings of ownership and affection toward the built objects. Therefore, making becomes a method for the children to have a primary role in their own education and to empower themselves in order to look at the world with novel perspectives and, why not, eventually change it. Tinkering fosters artistic expression, subversion, as well as producing, contributing enhancing, extending, changing, and re-creating reality [6]. In this context, we made use of tinkering with recycled materials in order to develop environmental consciousness and an ecological concern.

6 The Activity

We carried out the activity with twenty primary school children aged 9–11. In order to include the topic of smart city and in particularly that of environmental sustainability, we encouraged the pupils to use recycled materials and computational components. The activity was funded by the Department for Equal Opportunities of the Italian

Government, was designed to increase children's skills in STEM (Science, Technology, Engineering and Mathematics) and took place during a summer school (40 h). The activity is a part of a two-year project whose ultimate goal is to imagine the elements of the neighbourhood of the future using a "smart" perspective, through the design of "intelligent objects" that can respond to specific energy and environmental needs (pollution, waste collection, etc.). In the first year, in which the activities described were carried out, the theme of environmental sustainability, typical for smart cities, and the importance of garbage separate collection were conducted with the help of workshops based on Tinkering and Making. The children watched videos about recycling and the re-use of objects, about how materials can be reused, and the new object we create with it take on a new function in order to avoid waste, thus, optimizing the resources - that are not infinite (e.g. new bicycles made of recycled aluminium cans). Can waste be reused to create new objects? Can we design new objects, machines that can help us with waste and resource management? These we two of the questions to which the pupils answered affirmatively when they came up with pupil new robots that respond to specific needs in terms of environmental sustainability: for example robots that drive independently and clean the streets of waste; a drone that waters only when it recognizes a dry flowerbed, a robot that collects waste and empties bins; an intelligent box with sensors to facilitate opening it by people with disabilities. Each child has, therefore, drew/designed his own robot in their notebook, has individuated the constituent parts, the materials to be used, the functions that the robot can perform, and has created a model. Then the children were explained the notions of "smart" object, computational power, algorithms and following instructions and then each child reflected on that. In order to test how much the pupils have understood, technological kits (Lego WeDo 2.0) have been used, Lego bricks with which to build machines or robots that can move and perform actions thanks to sensors and components programmable with Lego or Scratch APP software. These software packages are based on block programming languages and allow the pupils to approach typical coding concepts, creating algorithms, using instruction sequences, conditional cycles (If.. then.. else), iterative (Do… while) to make their object move. The overall activity followed the basic steps of design and implementation, but the focus of the activity was the tinkering process.

6.1 Analyzing the Activity

Four week after the completion of the activity, we administered the 20 children a questionnaire. Its purpose was to evaluate it and find out the opinion of children about recycling after what we consider to be a significant amount of time for the information to settle in the mind of a child. Overall, the quantitative analysis of the multiple choice questions reveals appreciation of the activity. The children did not find the activity neither difficult nor out of the ordinary and this was interesting to us. The qualitative analysis of the questionnaire shows some other aspects. For example, when we asked the children to describe their robot and to write a little reflection on recycling in order for us to understand if this practice had influenced the children's environmental

awareness, their thoughts were sometimes vague, but overall, they showed some understanding of the usefulness of recycling.

"I think I will recycle every time." [N19]

"If we learn how to properly recycle we will maintain the world clean." [N20]

Other times, the awareness of material savings is more defined and developed, revealing a growing awareness for the ecological goal of the activity.

"To me, recycling is very important and objects should not be misused." [N09]

"Recycling materials is useful for the cities of the future, but also to spare trees, oil, gasoline, etc." [N12]

"If we recycle, we will maintain the world clean and we will save money." [N16]

They felt the activity as playful and they loved to learn new things and be with their peers; they perceived the environmental awareness as an important thing to posses.

"I like to recycle because waste can become much more than just waste" [N05]

"I've learned how important it is to recycle and how many good things you can create with waste." [N13]

During the activity, children learned to look at waste from a different perspective and were able to choose the suitable materials for the robot's anatomical parts they had to build. This new meaning attribution to waste materials was the central core of our activity, because during this interaction with materials children were able to achieve an abstract perception of environmental consciousness. Moreover, the robot functions are closer to the children's daily life, as we can see in the following excerpts from the transcripts of the discussions with our young participants.

"[my robot] has the body made from a plastic bottle, the eyes made with two corks, it has a light over the head, its purpose is to illuminate a room during the night." [N14]

"My robot has to collect metal from the ground. It has two magnets as hand. I have made it using a milk box, two paper rolls, a box, and two magnets." [N15]

When we asked them for suggestions on how to improve the activity, they understood that the question referred to recycling and they wrote sort of slogans like:

"Before throwing away an object think what you could make from that broken object. In two words: recycle it!" [N04].

Overall, the children's answers reveal that they had a positive experience, they enjoyed taking part in a creative activity based on making, and they showed greater sensitivity to the environment.

7 Discussion

The children participating in this activity were encouraged with this activity, we allowed the children to use their knowledge and skills to build something creative that came from their ingenious minds. Designing a robot was perceived as a game, but in fact it was an acquisition experience in a learning context where children not only used the skills they already possessed but acquired new ones on the topic of environmental sustainability, the value of recycling, and correct waste management, on the one hand and project work and relating hypotheses and solutions, on the other. When reconstructing the activity, we realized that we let them reflect, in a playful context, on the future consequences of current waste management actions. Moreover, the children's diegetic prototypes [24] told stories of sustainability through reuse, so they used the design activity as a tool to support imagination, knowledge, reasoning and interpretation. In this in a general sense, their visual and tactile dialogue with the recycled materials represented a *reflection-in-action* activity [20] that captured the physicality, fascination and specific features of the objects, which in turn made them realize the value of waste and the importance of its good use. With this activity, children were introduced to the DIY philosophy which is the base principle of collapse informatics; they were involved in the reconfiguration of discarded objects that acquired novel meanings by being assembled and repurposed. This can be considered not only a creative activity, but also has specific aspects of intentionality and subversion. Furthermore, the adaptation of waste materials to new contexts also allowed their creators to establish an affective relationship with them, through feelings of ownership and aesthetic pleasure. The main idea was that the material dialogue [14, 20] with the objects discarded by the parents and reused by the children was a playful way to develop the internalization of recycling value in a social context. This idea, in turn, is consistent with Vygotsky's interplay between inter-psychic (socialized psychological structures in a collective environment) and the intra-psychic categories (when children develop those structures starting from their own) [27]. Reflection in action [20], in this case, represents a conversation with the materials [14]. Their manipulation, the movement back and forth from the particular to the general, i.e. from the physicality to the intrinsic features of the waste materials, leads to a deeper appreciation of their existing qualities that can expend in order to re-contextualize household waste in novel contexts and with new functions. Therefore, making, in this case, stimulates a reflection about the renewable objects, representing in turn an expansion of existing mental frameworks toward overcoming the throwaway culture and the assumption of new positions of sustainable design. Recycling activity can be referred to the theory of Social Capital [1, 18]. The core structure of Social Capital consists in an individual's sense of belonging to a community in which there is a mutual benefit coming from all those who have certain behaviours. In this case study, children were asked to develop Social Capital by recycling waste materials in order to save them and prevent their scarcity in the future.

8 Conclusion

The described activity was aimed at activating and strengthening children's feeling of belonging to the community and life skills, while addressing the issue of environmental sustainability with ICT. The main goal of this summer school project was to design a sustainable "smart" city by addressing the environmental and energy issues of the present with the help of technologies of a near future. We approached our goals from a constructivist view point, asking the children to tackle problems in a playful and creative manner through tinkering. Firstly, every child imagined a computational object, and then made a prototype of that object with household waste; each of them decided autonomously the robot's shape and behaviour. This allowed us to introduce the issues of environmental sustainability, the importance of waste separation and the possibility to transform an object into another one with a different function. As a second step, the children shared their results with their peers in a group activity and received suggestions. The teamwork activities was also increased their social and communicative skills and their confidence in collective, creative processes. The final goal of the activity was to stimulate creativity, reflection, and a positive attitude towards sustainability. The results we gathered can give us some valuable insights for tackling environmental issues, which could be valuable for the whole HCI community as well as. DIY activities with the goal of reflecting on sustainability are critical-thinking activities in which children have reasoned about their own future and about the world that adults are leaving them. The described activity belongs to the area of HCI called research through design [28] through which we provided children with tools and procedures for critically analyzing the present and the future in relation to the current activity of waste management. We chose a tinkering activity because it is a hands-on, trial, and error-based learning process that encourages experimentation, team work, and cooperative learning in an informal environment. By exploiting creativity, manual skills and curiosity, pupils were able to develop skills that are fundamental in the contemporary world, such as critical thinking and the ability to innovate, they also learn to learn and increase their desire for lifelong learning. DIY activities enrich training programs with soft skills (communication and team working skills, problem solving and design thinking) and help to acquire life skills, for example citizen identity, as in the case study we presented above. The activity was not only aimed at allowing children to invent, but also at giving them the opportunity to reflect on the environment. This was possible by challenging the current situation (the abundance of waste) and finding alternatives (doing something useful with it). At the same time, we have stimulated skills like design thinking, reflecting on the future consequences of current/present behaviour, thinking about technologies (and their possible applications in daily life), civic engagement, and the development of ethical reasoning about the current situation. Children learned life skills related to the environmental sustainability, the importance of recycling, and the proper waste management all done in a playful way. Moreover, they acquired problem solving skills, they learnt how to carry on a project step by step, and how to test their own hypotheses and find possible solutions. To sum up, they strengthen their civic engagement, ethical reasoning, innovation skills, critical attitude, and team work.

References

1. Adler, P.S., Know, S.-W.: Social capital: prospects for a new concept. Acad. Manage. Rev. **27**(1), 17–40 (2002)
2. Arkhipov, V.: Home-Made: Contemporary Russian Folk Artifacts. FUEL Publishing, London (2006)
3. Bell, G., Blythe, M., Sengers, P.: Making by making strange: defamiliarization and the design of domestic technologies. ACM TOCHI12 **2**, 149–173 (2005)
4. Blikstein, P.: Maker movement in education: history and prospects. In: de Vries, M.J. (ed.) Handbook of Technology Education. Springer, New York. (2018)
5. Carlson, K., Schiphorst, T.: Designing interaction for designers: defamiliarization in user's creative decision-making. In: C&C 2013. ACM (2013)
6. Cermak-Sassenrath, D., Møllenbach, E.: Teaching to tinker: making as an educational strategy. In: NordiCHI 2014, pp. 789–792. ACM, New York (2014)
7. Desjardins, A., Wakkary, R.: Manifestations of everyday design: guiding goals and motivations. In: C&C 2013, Sydney, Australia, 17–20 June 2013 (2013)
8. Dix, A.: Designing for appropriation. In: British HCI Group Annual Conference on People and Computers, Swindon, UK, 03–07 September 2007 (2007)
9. Diamond, J.: Collapse: How Societies Choose to Fail or Succeed. Pinguin (2001)
10. Dunne, A., Raby, F.: Design Noir: The Secret Life of Electronic Objects. Birkhäuser, Basel (2001)
11. Dunne, A.: Hertzian Tales: Electronic Products, Aesthetic Experience, and Critical Design. The MIT Press, Cambridge (2005)
12. Dunne, A., Raby, F.: Speculative Everything: Design, Fiction, and Social Dreaming. The MIT Press, Boston (2013)
13. Freire, P.: Pedagogy of the Oppressed. Revised edition. Penguin Books, London (1993)
14. Ingold, T.: On weaving a basket. The Perception of the Environment: Essays on Livelihood Dwelling and Skill, pp. 339–348. Routledge, London (2000)
15. Nardi, B.: Designing for the future: but which one? Interactions **23**(1), 26–33 (2015)
16. Odom, W., Pierce, J., Stolterman, E., Blevis, E.: Understanding why we preserve some things and discard others in the context of interaction design. In: CHI 2009, Boston, MA, 04–09 April 2009 (2009)
17. Papert, S., Harel, I. (Eds.) Constructionism. The MIT Press (1991)
18. Putnam, R.D.: Democracies in Flux: The Evolution of Social Capital in Contemporary Society. Oxford University Press, New York (2002)
19. Resnick, M.: Lifelong Kindergarten: Cultivating Creativity Through Projects, Passion, Peers, and Play. The MIT Press, Cambridge (2017)
20. Schön, D.A.: The Reflective Practitioner: How Professionals Think in Action. Temple Smith, London (1983)
21. Sengers, P., Boehner, K., David, S., Kaye, J.: Reflective design. In: AARHUS 2005, pp. 49–58, Århus, Denmark, 21–25 August 2005 (2005)
22. Tanenbaum, J., Tanenbaum, K., Wakkary, R.: Design fictions. In: TEI 2012, Kingston, Ontario, Canada, 19–22 February 2012 (2012)
23. Tanenbaum, J.G., Williams, A.M., Desjardins, A., Tanenbaum, K.: Democratizing technology: pleasure, utility and expressiveness in DIY and maker practice. In: CHI 2013, Paris, France, 27 April–02 May 2013 (2013)
24. Tanenbaum, J.: Design fictional interactions: why HCI should care about stories. Interactions **21**(5), 22–23 (2014)

25. Tomlinson, B., Silberman, M.S., Patterson, D., Pan, Y., Blevis, E.: Collapse informatics: augmenting the sustainability & ICT4D discourse in HCI. In: CHI 2012, Austin, Texas, 05–10 May, 2012 (2012)
26. Tomlinson, B., Blevis, E., Nardi, B., Patterson, D.J., Silberman, M.S., Pan, Y.: Collapse informatics and practice: theory, method, and design. ACM TOCHI **20**(4), 1–26 (2013)
27. Wertsch, J.V.: Vygotsky and the Social Formation of Mind. Harvard University Press, Cambridge (1988)
28. Zimmerman, J., Forlizzi, J., Evenson, S.: Research through design as a method for interaction design research in HCI. In: Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (CHI 2007). ACM, New York (2007)