
Digital Natives and Cardboard Cubes: Co-Creating a Physical Play(ful) Ideation Tool with Preschool Children

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Abstract

This presentation highlights a study on the interactive design and implications of a playful co-creation tool, Comicubes, which combines a two-dimensional blank cardboard canvas with a three-dimensional, open-ended toy medium: the cube. In our study, we tested the concept's functionality as an ideation tool suitable for different target and age groups, as well as its potential as a creative physical platform that encourages design thinking, allows for playful manipulation, and invites interaction. In workshops designed for preschool-aged children, participants were asked to create a plaything of their choice by applying various art supplies to blank cardboard cubes. The workshop findings indicate that the children in our test group, as digital natives, were able to use the Comicubes platform to co-design and create a physical plaything and develop associated play patterns and open-ended (toy) or rule-based (game) ideas for its use.

Author Keywords

Co-creation; playful tool; participatory design; design techniques; preschool-aged children; digital natives.

ACM Classification Keywords

H.5.m [Information Interfaces and Presentation (e.g., HCI)]: Miscellaneous; H.5.2 [User Interfaces]: Evaluation/Methodology, User-Centered Design; K.8.0 [Personal Computing]: Games

Introduction

This paper investigates how preschool-aged children engage with Comicubes [1], a three-dimensional tool that stimulates design creativity and interaction. We present an empirical study focused on how children interacted with this ideation tool in a workshop setting. The children in the test groups (N=13), aged 6 and 7 years, were asked to create a plaything using two cardboard cutouts that could be formed into cubes and art supplies, such as coloring pens, pictures, and letters printed on cardboard squares. We consider the cardboard cubes as forms and their blank surfaces as an information layer that can be enhanced with text, images, and even digital technology (such as apps) involved, hybrid features which connect the physical base material with digitally operated devices. Prensky introduced the term “digital natives” to refer to the generation that has grown up with digital technologies, so much so that these technologies are a part of their worldview [2]. For digital natives, ways of acting and being in the social world are framed by their experiences with technology. Their worlds are heavily influenced by these technologies. As Zenvenbergen noted, one only has to consider the toys produced by global toy manufacturers and the changes over the past 20 years to see how digital technologies are changing the experiences of young children. In turn, such experiences change these children’s dispositions to learning and behaving [3]. For many players, the focus is on fun, entertainment, and pleasure, but the age of

the ludic turn also manifests in game and toy-related skill-building, self-realization, and other forms of creative behavior. Lacasa et al. expressed a similar notion when they wrote that “playing, imagining, and creating are indispensable activities that humans, young or old, have to learn in the 21st century” [4]. According to the literature [5], however, the importance of the material dimension of play is not diminishing, although Western culture is digitalizing and dematerializing in many ways [6]. In other words, physical (tangible) toys and games are still popular among different age groups. It is therefore possible to verify the existence and continuous play potential of classical play media such as the cube, which as a form has its point of origin in a physical object but is used today in both material and digital contexts as a basis for different play ideas. The present research is interested in how digital natives perceive and interact with the physical Comicubes, which use simple paper-based technology and are introduced in greater detail in the following section.

Study Background and Research Questions

This paper sets forth a new technique for developing and simultaneously co-creating an ideation tool that employs simple, approachable, yet playfully inviting paper technology. In previous stages of our research, we invited university students, teachers, and artists to test and present their creations based on the Comicubes ideation tool, and these creations provided a starting point for concept creation and the construction of physical prototypes for playful uses. In this paper, we present a case study in which preschool-aged children were thought of as design partners and collaborated in the overall design process for an ideation tool, which is being constantly re-evaluated by



Figure 1: The original Comicubes toy-game hybrid is considered the point of departure for the design tool presented in this paper. It combines a two-dimensional serial image with a three-dimensional and therefore more open-ended toy medium: the cube. This format is well recognized in both play cultures and pedagogy through, for example, various blocks sets, like Froebel gifts. Playthings such as alphabet and puzzle blocks, construction toys, and brain teasers have been used successfully. In terms of games, the form is often associated with dice. Recently, the popularity of games like Minecraft have proven the sustainable attraction of the cube shape.

The Comicubes tool presents an ecologically sustainable, economically sound, and potentially more inclusive ideation tool than the more expensive plastic bricks often used as design tools. The advantage of cardboard cubes compared to many other materials used in prototyping is their capacity to be enhanced with various textural dimensions or layers of information, whether physical or digital.

the authors through testing with new user groups. In this way, the preschool-aged children, referred to in this paper as digital natives, contributed to the design knowledge regarding possible interaction contexts for the work-in-progress ideation tool. Consequently, the study also represents design research conducted with children, as it discusses the involvement of children in the design process as they co-developed understandings of the tool's conceptual and physical aspects. Interaction design focuses on user behavior. Thus, our study is interested in how the participants in our test groups interacted with the playful ideation tool and with other members of the test group to communicate about the ideas for play that they associated with their creations. On the one hand, we want to know how preschool-aged children co-create play-object-like prototypes using the ideation tool. On the other hand, we are interested in how the blank cardboard cubes invite them as users to design new playthings. In particular, through the workshops, we investigated the following interactions: 1) How do preschool-aged children, as digital natives, experience Comicubes as a tool that helps them create their own playful concepts? 2) What kind of playful elements or play patterns do preschool-aged children associate with their created playthings based on the tool? 3) How do the participants in this case study, as both digital natives and preschool-aged children, interact with their creations in both solitary and social contexts?

Comicubes: A Conceptual and Physical Ideation and Co-Creation Tool

The Comicubes tool is a tangible physical object that allows for three-dimensional manipulation. The tool affords various forms of interaction, depending on its users' age and skills. For instance, younger groups may

use the tool as the basis for developing ideas around play, as explained in this paper, whereas designers, for example, can use the tool to explore, narrate, and build on conceptual ideas for products, brands, and services. Both physical and digital manipulatives can require bimanual and haptic interaction skills and the facilitation of spatial tasks [7]. Following Resnick and Silverman [8], tools that support creative thinking should “support exploration; have a low threshold, high ceiling and wide walls; support many paths and styles; support collaboration; support open interchange; make it as simple as possible; choose black boxes carefully; invent things that you would want to use yourself; balance user suggestions with observation and participatory processes; iterate; and design for designers.” The Comicubes tool combines ideas associated with toys, games, and comic-style storytelling.¹ The cube format has longstanding roots in the history of play, and their simplicity, familiarity, and ease of use speak for cubes as play(ful) tools that stimulate design creativity and co-creation [9]. Ullmer and Ishii noted that this tangible format, which invites touch, also supports peer collaboration and facilitates communication [10]. Furthermore, it provides “multiple access points” [11]. When considering the potential of the cube format from an educational perspective, it is important to pay attention to its capacity to promote social interactions and active, engaged participation [12]. In our case studies, we discovered the potential of the Comicubes to afford prototyping beyond the context of toys, games, and hybrids, including both physical and digital elements, to play patterns in

¹ For reference, we have constructed an introductory video presentation about some of the hypothetical play patterns the Comicubes concept holds. See video clip: <https://www.youtube.com/watch?v=sRGss4sVF-4>.



Figures 2 and 3: Workshop setting at the kindergarten. The workshop began by having the children fold the paper cutouts into cardboard cubes.



Figure 4: Some workshop participants enhanced the cube's information layer by drawing with coloring pens.

relation to both open-ended toys (“sandbox games”) and structured play concepts (rule-bound games). One of these prototypical ideas for use connects the ideation tool with service design. Regardless of Comicubes’ capacity to function as a “phygital” device, meaning a hybrid artifact encompassing both material and digital components, this study is primarily interested in their capacity to function as a simple prototyping platform that invites young children to co-design ideas for object-based play.

Data and Method

Experimental design: Co-creating for interaction with preschool-aged children

Our research aims to explore children’s creativity and co-creation capabilities. In the study, we tested the potential functionality of the Comicubes concept as an experimental point of origin for a plaything, or in other words, as a creative platform that fosters design thinking and allows for playful manipulation. First, we showed the participants existing versions of the prototype. Then, we allowed them to design their own playthings. In this way, we tested the concept’s potential to function as a creative platform that fosters design thinking and allows for playful manipulation.

Participants and play testing

The ethnographic fieldwork that generated the empirical data for this article was carried out in 2016 in a Finnish kindergarten class that specialized in art education. Inspired by the new child research paradigm [13], which emphasizes research *with* children rather than *on* children [14], the study aimed to identify what

constitutes an interesting plaything. In the workshops for (N=13) preschool-aged children (aged 6–7 years), participants were asked to create a plaything of their choice by applying various art supplies to blank cardboard cubes. The workshops began with an introductory segment in which the first author showed two ready-made Comicubes to the children and then asked them to design a plaything out of the given materials. The author guided the children in how to fold the cutouts and form a cube. There were two kindergarten supervisors present during each workshop segment to assist the children. During the 30-minute workshops, which were documented through recorded video and photography, each child created two individual Comicubes.²

The children were able to observe other participants’ design process as they created their cubes. In addition to talking with the children, we also observed their actions and attitudes to access their perspectives on playing. As a result, our data collection methodology involves video ethnography, videotaped interviews and photographs. This data was used to involve the children in describing and interpreting their interactions with their creations and to gain a firsthand account of their perspectives.

In Group 1, all the children chose to use ready-made images in the form of leftover memo tiles donated by a board game manufacturer. In Group 2, some of the children picked up coloring pens and drew on the

² Most of the participants needed help from adults in assembling the cardboard cutouts into cubes. This indicates that introducing the intentional limitation of having each child design only two cubes each within the 30-minute workshop presented a suitable task.



Figure 5: The workshop invited the participants to take action and share ideas with each other.



Figure 6: The workshop enabled shared play experiences as the participants reflected upon the play patterns they associated with their individually created playthings.



Figures 7 and 8: After the creation phase of the workshop, the preschool-aged children were asked to demonstrate the play patterns they associated with the playthings they had created.

cubes. During the workshops, the participants were asked about the potential uses for their emerging playthings. Both groups made the connection between the cube and a familiar board game element: the dice. In fact, one child decided to make an actual dice out of one of the cubes. After the workshops concluded, each participant was taken to another room and interviewed about his or her design. Each child was asked to present his or her creation and demonstrate the potential uses for their design in a “show-and-tell” style. The children were also asked about what they found fun about the design process and what they considered difficult.³ To get another perspective on how their creations could be used in play, each child was asked to present the plaything to another child in the group and demonstrate the play patterns they associated with it.

Results

In this study, we investigated how preschool-aged children, as digital natives, experienced Comicubes as a tool for creating their own playful concepts in a workshop setting. Based on our study’s findings, the participants were easily enticed into a playful co-creation situation once they began to interact with the material. The participatory research process of working with young digital natives demonstrated that they are capable of understanding what designing for play with physical materials means in a group situation. All participants were able to identify a play pattern for the two cubes they had created. The most frequently

³ For reference, see video clip: https://www.youtube.com/watch?v=0iqSCB_S-S4.

mentioned and demonstrated play patterns were throwing, rolling, rotating, and stacking the cubes. We also noticed that the children, when verbalizing their discovered affordances of the cubes, began to discuss and mimic each other’s interaction with the materials. Many participants made a connection between the cube’s shape and a familiar element: the dice. One participant also informed us that the form was reminiscent of a familiar character from a digital game.⁴ When interviewed after the active phase of the workshops, after the creations were ready, most children were able to demonstrate the play patterns they envisioned to the first author through verbal utterances. However, when showing another child the possible play patterns associated with their play objects, most of the children used more specific movements (see Figures 7 and 8) and thus took a more embodied approach.

The initial findings suggest that in a digital age where technology is ubiquitous, children are still drawn to creating physical three-dimensional play media and can communicate about the various play patterns associated with them. As participants in this case study, the preschool-aged children were able to observe each other’s work and exchange ideas while prototyping. When the creation period for their play concepts came to an end, the children were encouraged to communicate about their creations’ potential play affordances by illustrating their interactions with their playthings. The information layer most children used in creating their cubes, that is, the ready-made images, was considered an important part of the created play concepts.⁵

⁴ For reference, see video clip: <https://www.youtube.com/watch?v=mzep7ZuCKUE>.

⁵ For reference, see video clip:

Limitations and Future Research

The participants' level of digital exposure was not measured in this study. In future research, it would be interesting to explore possible differences between preschoolers who have had great access versus limited exposure to digital technologies. In this study, the participants were asked about whether or not the cube format reminded them of any games or toys they had played with before, without specifying either physical or digital games or toys. One child noted that the shape was reminiscent of a game character with a cube-shaped head and body.

We believe that the preschoolers in our study will be exposed to a significant amount of digital technologies once they enter the school system following their early kindergarten education. Consequently, we find it important to emphasize exposure to creative physical materials that can be transformed into three-dimensional objects.

Nevertheless, as printing technologies develop, it becomes more and more probable that even mundane materials such as paper will provide access points to digital worlds. It is the hybrid potentialities that exist between the two-dimensional and the three-dimensional and between the material and digital that present interesting possibilities for both the design and user experiences of 21st century playthings.

The participants who chose to attach ready-made images to their cubes put time into deciding which pictures (e.g., numbers or animals) to use. These decisions were often coupled with brief narratives on favorite animals or, for instance, the traffic sign system as a part of their created play concept. The children who decided to enhance their cubes in other ways were more inclined to put their cubes in motion by throwing or rolling them without giving detailed descriptions of their play concepts. In terms of further research, it would be interesting to explore how the design process might advance if the ready-made visual elements were not available to the children. Furthermore, and perhaps surprisingly, in addition to their capacity to invite to play, some of the children highlighted in their comments the educational value of the cubes they had created.⁶ This participatory design task can be carried out with other types of participant constellations, for example, adult-child pairs, children working in pairs, etc. This would allow researchers to capture the thought processes behind the prototyped designs in greater detail.

Discussion and Conclusion

We propose that the Comicubes concept has the potential to function not only as a physical, playful platform that invites users to design and co-create toys and games, but also as a conceptual tool that may be used as an easy-to-use, ecologically sustainable, economically sound, and therefore inclusive ideation tool in interaction design, as it facilitates communication between designers, test participants, and interaction design researchers in many ways. To

conclude, the cardboard Comicubes concept can be applied to many different target groups and used in place of more expensive tools, such as Legos, that have been used in interaction design. One important benefit of the cardboard cubes is that they provide endless opportunities for both toying in terms of spatial play and constructing. Perhaps even more important is the potential for information to be presented in many ways, including the use of traditional methods; images, words, numbers, and combinations thereof; and a technologically enhanced information layer. As previously described, the inviting, play(ful) qualities of the cardboard cubes present a simple, customizable interface and a never-ending potential to be enhanced with different elements (both material and digital) in terms of its information layer. Possible avenues for future research include further testing with children incorporating the use of hybrid elements on the cardboard cubes, for example, in exploring new printing technologies. Another possible direction is to investigate in greater detail how the physical, play(ful) ideation tool can be implemented in the context of service design, for example, by involving children in the ideation and co-creation of services targeted to them, including both entertainment and educational services.

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<https://www.youtube.com/watch?v=bMEIMKL-fdc>.

⁶ For reference, see video clip:

https://www.youtube.com/watch?v=owsGJRcdt_w.

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