

THINKERSPACE:

DESIGNING FOR COLLABORATION AROUND THE BOOK AND BEYOND

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ABSTRACT

Innovation, collaboration and system thinking are increasingly recognized as skills that can be useful to children, and that can help ensure their success as citizens and workers in the 21st century. Seeking to improve opportunities for young people to develop abilities and competencies for the future and to narrow the complexity gap left by *No Child Left Behind* (the US federal law of 2001 that enacts the theories of standard-based education reform) when children are confronted with more conceptual thinking, a new genre of collaborative environments is being envisioned, called ThinkeringSpace.

As a hybrid system of networked and remotely accessible physical environments, ThinkeringSpace seeks to inspire children to come together face-to-face to collaborate and tinker, reflect upon what they do and discover and elaborate their ideas in ways they can share with others. This paper gives an overview of the ThinkeringSpace system and its development. In addition, it discusses the process of designing for collaboration, whether face-to-face, stigmergic, online or hybrid, illustrating it with interactive prototype concepts.

INTRODUCTION

Creative thinking and collaboration skills are increasingly being recognized as some of the skills that separate students who are prepared or not for the ever more complex life and work environments in the 21st century. According to the Partnership for 21st Century Skills (2007), who gathered business community, education leaders, and policymakers to define a view of the future, three major sets of skills will be important for children: learning and innovation skills; information, media and technology skills; and life and career skills.

No Child Left Behind, however, has turned the focus of schools to the improvement of basic skills only, narrowing what many schools teach, leaving children unprepared for the future ahead of them. According to Toppo (2007), annual testing requirements in math and reading have absorbed much time and energy at the expense of other aspects of curricula, and performance improvements in the lower grades are often not reflected later – leading to a complexity gap when kids are confronted with more conceptual thinking in higher grades. With that in place, other informal learning venues, then, become necessary to collectively expand the opportunities children have to succeed.

Concerned with the educational needs of children, the MacArthur Foundation launched a five-year, \$50 million digital media and learning initiative in 2006 to: 1) help determine how digital technologies are changing the way young people learn, play, socialize, exercise judgment and engage in civic life; 2) learn how learning environments may be changing; and 3) seed innovation for continued growth. As part of the third wing of the initiative, the ThinkeringSpace project is focused on envisioning new informal learning spaces, to be situated within libraries, to captivate the Internet generation (Howe and Strauss, 2000; Oblinger and Oblinger, 2005), allow children to explore their 'own wonderful ideas' (Duckworth, 1996) and support the development of necessary skills and competencies not addressed in the U.S. traditional school system.

Having explained some of the motivation behind the development of ThinkeringSpaces, the following sections give an overview of the ThinkeringSpace system and the design and development process. In addition, they explain how these special places can support collaborative experiences and discuss the process of designing for collaboration.

THINKERINGSPEACE

OVERVIEW

ThinkingSpaces are collaborative environments that seek to support physical and virtual exploration, co-authoring and co-construction. These special places within content-rich institutions take children through the dialectic of tangible and symbolic, generating new integrated knowledge and skills. Although initially focused on school-aged children in libraries, it potentially applies to a wide range of ages and contexts – from after-school program to work space, supporting hybrid interaction and stigmergic collaboration (Grasse, 1959), a method of communication where individuals convey meaning to one another by modifying their local environment. Overall, it celebrates the book – making it the starting point for physical-virtual exploration and discovery – and allows children to follow their ‘own wonderful ideas’ and interests, co-construct their experiences, co-author stories and share the evolving results with others.

Structured to provide ways for children to make their creations and ideas visible and to share them with others, by adapting to different individual interests and styles, they focus on promoting productive inquiry and multiple ways of knowing. Combining smart spaces, tangible interfaces, large scale multi-modal technologies, multi-input digital devices, sensorial objects, symbolic cues, open-ended activities and evolving content, ThinkingSpaces create new experiential opportunities for exploring through tinkering and interacting both locally and remotely. By promoting fluid interplay of physical and virtual experiences, these environments introduce a new genre of hybrid interactive spaces.

System Description

Conceived as a hybrid system that combines physical and virtual environments, ThinkingSpace aims to promote and support thinking skills for the 21st century. Mainly designed to encourage children to collaborate face-to-face, it also extends children’s opportunities beyond the physical space by accommodating remote and mixed reality, or hybrid interactions. ThinkingSpace physical installations are: platform-based, freestanding, scalable, reconfigurable, independent of building architecture, easily monitored and maintained and self-contained with their own infrastructure. Combining multi-user input and large scale technologies, they provide new opportunities for doing things together through shared input and output control.

The virtual extension of ThinkeringSpace physical environments is called ThinkerNet. It allows tinkerers to: build individual and group profiles based on one's interests, locate interest groups and mentors, connect to a network of mentors of all ages, brainstorm, collaborate, access tinkering projects to build upon, store one's history of interactions, develop a portfolio and share creations. It encourages community building through online membership networks, while paying attention to children's cyber safety.

Design and Development Process

The design and development process of the ThinkeringSpace system began in the summer of 2006. This initial phase, known as 'framing the project,' included: a) identification of working assumptions, b) definition of project approach, c) formulation of initial research questions, d) review of literature review on learning theory, best examples of existing learning environments, newly available technologies, flexible structures and social trends, e) development of conceptual frameworks from insights and speculation drawn from the influence of the literature review, f) derivation of early best-guess actionable design criteria and principles, g) generation of conceptual, structural and behavioral prototypes (Moura, Fahnstrom, Prygrocki and McLeish, 2008), h) development of selected concepts in low level form, i) conduction of user observation within the prototype space, j) analysis of data and iteration and refinement of the design criteria and principles and k) initiation of website (<http://www.ThinkeringSpace.com>), describing the project and documenting the design process. Some of the high level design principles that were proposed during this initial phase are: empower children to become authors, provide affordances for collaboration, support multiple interaction models and make the environments flexible.

The second phase took place during the summer of 2007 and was concerned with understanding libraries in the Chicago Metropolitan area. It involved the mapping of this library system and in-depth study of ten libraries. Through secondary research, important facts, issues and forces affecting libraries were identified. Through primary research, a rich window on specific library operations became available. This process made use of various information gathering methods and tools, such as video ethnographic observation, individual and group interviews, day-in-a-life journals and questionnaires. The main focus was placed on understanding the needs and rituals of librarians, library staff and patrons, to identify patterns of behavior. Subsequent analysis led to study insights that further informed the design of *ThinkeringSpaces*. These included: *More Than Books* – libraries are much more than warehouses of books or media; *Constant Change* – libraries have made continued efforts to meet patrons' expectations and keep up with technology; *Underused Expertise* – librarians have a broad range of expert skills that are little known and utilized by the public; and *Life-long Relevance* – patrons life-long interaction with libraries vary highly (from frequent to no use of the library). From these, implications for design were identified, such as: creating opportunities for inter-generational interaction and assessing interests and needs of different age groups better.

The current phase deals with learning by prototyping; it includes the iterative development of a meta-prototype space located at the Institute of Design, Illinois Institute of Technology in Chicago. The goal of this meta-prototype, consisting of the post and beam structural frame and technology-enhanced spatial elements, is to help define the prototype installations that will be situated in real libraries. Also included in this phase is the design of interactive prototype concepts that make use of the spatial elements, as exemplars of the range of activities that can be supported by the system. Finally, the proposed in-situ prototyping in a Chicago Metropolitan area library includes user observation and iteration of the concepts and spatial affordances.

The next and final phase of the grant is concerned with guiding integration of *ThinkeringSpace* into the library community. Informed by prototyping, it includes the description of the final implementation strategy, overall system description and guidelines, that will allow library administrators and librarians to define how a *ThinkeringSpace* installation will look in their library, and what theme and activities will be implemented.

The following section defines and describes different types of collaboration, and discusses the process of designing collaborative experiences.

COLLABORATION

Collaboration (Camarinha-Matos and Afsarmanesh, 2006; Fuks, Raposo, Gerosa, Pimentel, Filippo and Lucena, 2008; and Dillenbourg, Baker, Blaye and O'Malley, 1996) can be defined as: a process where two or more people plan and work together towards a common goal, in which individual contributions to value creation are difficult to determine; a process of co-engagement in acting, thinking, planning, deciding and working, which results in the emergence of shared understandings and a creative output; a process that begins with developing a mutual vision and ends with implementing and assessing the action plan; or a process through which a group of entities enhance the capabilities of each other. Elliot (2007, p.31) proposes that the definition of the term collaboration can be consolidated as the following: “[it] is the process of two or more people collectively creating emergent, shared representations [both internalized and externalized] of a process and or [creative] outcome that reflects the input of the total body of contributors.”

In the literature across disciplines, often times the word is used interchangeably with terms such as cooperation and coordination. The first term, however, refers to collective activity of operating together, aimed at a shared pursuit or goal, without a creative component. And the second term refers to a fundamental enabling requirement for collective activities, even competitive ones, that involves bringing parts of a whole into proper combined order, or joint organization, and which is not characterized by the presence of a problem or dependent on either convergent or divergent exploration or production.

Different Types of Collaboration

Traditional face-to-face collaboration is characterized by co-location, co-temporality, multimodal communication, shared representation, iterative oral discourse, social negotiation and creative output. Ideally with two to six participants, these collaborations require less comfort with ambiguity, since doubts can be more quickly clarified by the group. If supported by the right technologies, these small groups can work well in hybrid and virtual contexts as well, both synchronously and asynchronously.

In the case of larger groups – beyond twenty-five participants, to a mass of tens or hundreds of thousands, however, collaboration becomes dependent upon stigmergy (Grasse, 1959), a method of communication in which individuals convey meaning to one another by altering their local environment. The stigmergic type of collaboration (Elliot, 2007) is characterized by embodied interactions (Dourish, 1999) and frozen actions (Norris, 2004) as a means of communication, leading to a creative output; these are extended and augmented by computing and digital networks. Shifting away from discourse and social negotiation, which go to the background, these collaborations allow fast and seamless integration of participant contributions to the group project, making it possible for individuals to contribute without discussing or justifying, or to discuss without contributing.

Supporting Collaboration

Supporting collaboration implies helping users to do things together, share information, expertise, risks, resources, responsibilities and rewards, and develop a unified view and action plan. Because collaboration, especially of the traditional type, involves reciprocal trust and seeks divergent insights, and because it is affected by the attitude, experience, skill and personality of the collaborators, supporting it requires attention to emotional, cognitive and social factors. Some important aspects to consider are the need to encourage: interest, motivation, reflection loops, collective dedication, teamwork strategy, group management, open communication, active listening, continuous group assessment, ongoing consensus building and sustainable interaction.

Notably, collaboration benefits from a shared environment for archiving and sharing information – ideally supporting both face-to-face, stigmergic, online and hybrid interactions. And interestingly, it does not require leadership and, in fact, can usually bring better results through decentralization and egalitarianism (Spence, 2005).

DESIGNING

FOR COLLABORATION

Designing for collaboration – whether face-to-face, stigmergic, online or hybrid – starts with designing for communication, coordination and cooperation, as well as supporting both divergent and convergent thinking as well as creative outputs. Designing for communication involves supporting the negotiation of meaning – synchronously or asynchronously – across contexts. Designing for coordination includes supporting group members to be organized, be continuously in tune with one another and developing shared understandings. Designing for cooperation considers supporting joint operations in the shared workspace. Designing for convergent thinking relates to helping participants develop a unified view and action plan in their search for solutions to problems. And designing for divergent thinking and creative output takes into consideration supporting a process that moves from orientation to preparation to analysis to ideation to incubation to synthesis and to evaluation (Osborn, 1953). Overall, designing for collaboration refers to supporting people in working together, whether co-located or not. It is about supporting individual and group needs over time during collaborative activities.

Designing Collaborative Spaces for Tinkering Together

Within ThinkeringSpace installations, four main types of collaborative activities are being designed, supported by spaces and technologies: a) face-to-face multi-input collaboration; b) side-by-side multi-input large-scale collaboration; c) cross-media linking, artifact-based stigmergic collaboration; and d) hybrid collaboration, combining face-to-face interaction and the possibility for online mentoring.

An example of face-to-face multi-input collaboration being developed at ThinkeringSpace is a table with multi-input control. This circular collaborative table screen surface, or ‘pond’ (*figures 1 and 2*), around which a group of users can stand, allows them to simultaneously input, browse and select information through multiple input and control devices, while maintaining face-to-face contact, and together, for instance, co-author a story or solve a problem. The central concept is to make it necessary for users to collaborate in order to accomplish any task.



FIGURE 1
ThinkingSpace Meta-Prototype Space, showing the circular collaborative table or 'pond' under critical discussion



FIGURE 2
ThinkingSpace collaborative table in use.



An example of side-by-side multi-input large-scale collaboration is the wall-sized screen augmented with wand controllers or batons for large-scale group interaction. In this activity, a group of users can stand in front of a large screen (*figure 3*) and share a baton in the input control of the interaction, while organizing information that, for example, other local users send to the screen through personal devices, such as cell phones. This type of setting allows users to create a project presentation that

integrates multiple modes of representation of information.

An example of cross-media linking, artifact-based stigmergic collaboration, also taking advantage of the wall-sized screens, is the story creation activity. It makes use of artifacts, such as books, as the starting point of the conversation, allowing users to cross-link different media to it, such as a story-telling video they produce, a book review they write

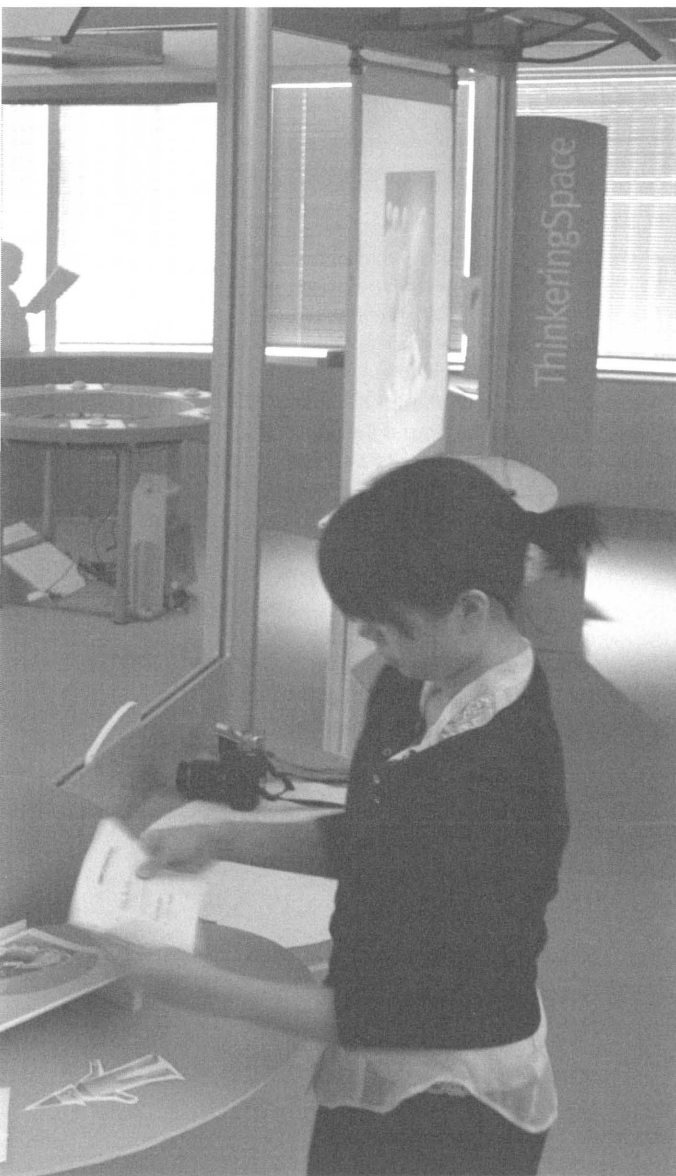


FIGURE 3
ThinkingSpace Meta-Prototype Space showing two of the large interactive screens.

or a website with related pictures they select. Upon return of the book, others can access comments made and links authored in relation to it, leading to all the different pathways that were created around and beyond the book – working as living trails for others to find, supporting stigmergic collaboration. Combined with user profile creation and identification of book interests, novel opportunities for networking and interacting face-to-face with people having similar interests could arise.

And an example of hybrid collaboration is the use of the large screens with batons and local webcams to combine face-to-face collaborative activity with the potential for online mentoring. This setting can allow participants to collaborate with others locally, while interacting with mentors online through ThinkerNet, making use of text or video input and output.

CONCLUSION

This paper gives an overview of the ThinkeringSpace system and design process. It highlights some of the issues related to the design of collaborative systems and describes different types of collaboration, giving examples of interactive prototype concepts that can support them. Currently, the ThinkeringSpace team is iterating the meta-prototype space situated at the Institute of Design, Illinois Institute of Technology, that will inform both the prototype installations that will be located in libraries within the Chicago Metropolitan area, and the final implementation strategy with its overall system description and user manual that will guide the configuration of new ThinkeringSpace installations.

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