

# Designing for Participation in Public Knowledge Institutions

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## ABSTRACT

We address the challenges facing designers of interactive technologies for public knowledge institutions such as museums, libraries and science centres. We argue that visitor participation is a key concern for these institutions and present a theoretical framework for understanding participation grounded in pragmatist philosophy. We then present design work carried out in three different settings, namely a museum, a combined aquarium and science centre, and a municipal library. Based on a discussion of these design cases, we offer six design considerations for designing for participation in public knowledge institutions.

## Categories and Subject Descriptors

H5.1. Information interfaces and presentation (e.g., HCI): Multimedia Information Systems: Artificial, augmented, and virtual realities.

## General Terms

Design, Theory.

## Keywords

Interaction Design, Museums, Libraries, Knowledge, Public Institutions, Pragmatism, Theory, Design Cases.

## 1. INTRODUCTION AND BACKGROUND

Information technology in public space is increasing drastically, wireless networks allowing internet access almost everywhere, mobile devices, new infrastructures and communication protocols, which offers fantastic opportunities for interaction designers. There is an increasing tendency of going from desktop computing to a third wave of computing, where the applications and use contexts are broader and intertwined. Information technology and computational power is no longer only connected to the workplace, but is used in both private and public, at home, in our everyday lives and for social, cultural and emotional experiences.

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NordiCHI 2008: Using Bridges, 18-22 October, Lund, Sweden  
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We have come to expect encounters with this technology everywhere, but there are still some domains where this adoption takes longer. In this paper, we will focus on public knowledge institutions as examples of this. We define public knowledge institutions as places accessible to the community whose functions are to serve as repositories for and disseminators of knowledge; we shall further define the concept of knowledge in section 3.1.4.

As institutions in society, libraries, museums and science centres share a history of maintaining collections and making these available to the general public. Curators and librarians have been the gatekeepers of knowledge in these institutions. Moreover, libraries and museums have been significant not only as institutions but as particular places for public engagement. However, these public knowledge institutions are increasingly challenged by the proliferation of the Internet and mobile services. Our desktop computers provide access to a world of information from the comfort of our own home and mobile devices are rapidly becoming a medium for pervasive access to online resources. It is no longer necessary to visit the library to find the right book; searching and ordering may be done in advance, reducing the library-visit to a matter of picking up the book. Though many of these services are desirable from an ease of use point of view, they also contribute to the depopulation of the physical library.

Similarly, the traditional role of museums as a societal centre of knowledge is changing. An abundance of knowledge about any given subject on cultural or natural history is available from online resources. Moreover, many institutions present their collections online and link these to similar resources from around the world. In efforts to meet the challenges of new media, some museums have begun to provide virtual tours of the museum space in 3D linking the visual qualities of exhibited items with video, audio and text. Furthermore, research efforts have explored ways of folding digital media contents with the exhibition space in the form of audio guides (e.g. [14], [1]) and augmented reality installations [34].

Within libraries efforts have also been made to accommodate the advance of digital media. Most libraries provide digital catalogues where people can search using web-based services. Libraries have also extended the media services provided, from books, journals, etc. to subscriptions to online resources. In the wake of these developments, a more fundamental concern has been voiced regarding the very basic ideas of these institutions in modern society. Within the realm of museums, it has been argued that most modern museums are fundamentally based on outdated models of communication that conceptualize communication as a

linear process of transfer from one mind to another [17]. This model assumes that the knowledge communicated in museums is objective information, transferred from a value-free authority to a uniformed receiver [Ibid.]. The model builds on an image of people as merely absorbers of stimuli, outside any socio-cultural context. Libraries have faced similar criticism, and voices from within both institutions have argued for the institutions to adopt a more dialogical ideal.

The idea of ‘Library 2.0’ [1] has been proposed (inspired by the idea of ‘Web 2.0’) as a model for libraries where participation and user-generated content is valued and where the community shapes the library content. From within Museums, a ‘New Museology’ [31] has been discussed, framing the museum as a fundamentally interactive place, where visitors are actively debating and constructing knowledge. Both approaches stress the issue of community participation as a cornerstone in re-establishing the role of these institutions. In Library 2.0 this is very much framed in terms of web-based services whereas New Museology maintains the commitment to the place of the museum.

In this paper we extend the concern for participation in these public knowledge institutions and consider this issue from the perspective of interaction design. We acknowledge that the issue of participation entails strategic, societal and political challenges. We will however confine our discussion to the realm of introducing participatory, digital technologies in existing, physical institutions. There is arguably good reason for considering these institutions as stretching beyond their physical boundaries, but for the sake of a focused discussion, we will primarily explore participation as it may be situated within the physical context of these institutions. As such, our approach can be seen as an attempt to bridge the realm of digital material to the physical spaces of public knowledge institutions through the concept of situated participation.

In the following section, we consider the issue of participation in public institutions and review the efforts made to introduce and design technology within this area. We then outline a pragmatist approach for understanding participation based on the place as a resource for knowledge. We qualify our approach through three cases that highlight significant aspects of participation and serve as exemplars for interaction design. Finally, we sum up our explorations in six design considerations intended to support designers in designing for situated participation in public knowledge institutions.

## 2. INTERACTIVE SYSTEMS IN PUBLIC KNOWLEDGE INSTITUTIONS

As libraries, museums and science centres have begun to explore the use of digital technologies, these institutions have received increased attention from a variety of research areas. Museums have proved a suitable setting for exploring key areas of Ubiquitous Computing, such as context aware systems and augmented reality. In particular, context aware tour-guides have been studied at length in the literature [25]. The general rationale is to provide information in the form of audio, images or video relative to the context (often position) of the visitors. Besides the benefit of context specific information, these studies point to the potential social aspects of the tour-guides; being able to play audio out loud for co-visitors [33] or eavesdropping on other visitors’ tours [14.] Moreover, museums have provided a well-suited context for using augmented reality to reconstruct historical artefacts [2]. Not only does augmented reality offer exciting visual

means of enhancing exhibitions, it is also argued that these technologies offer potentials for learning as objects may be manipulated, combined and made interactive [34]. The issues of social interaction and participation are reported as central to most of these studies. Efforts in CSCW have explored these issues in more detail, highlighting how the museum experience is fundamentally shaped by social interaction and participatory activities (e.g. [16]).

In contrast to museums, interactive technologies within libraries have mostly focused on digital libraries and traditional interfaces operated by mouse, keyboard and screen. There is extensive research in various digital services for libraries e.g. library web sites, library search engines, sociable web services based chat rooms connected to the library website and digital comments on books; services and developments supporting views the future library as digital, virtual and distributed [21]. Little, however, has been done in trying to make the physical space and artefacts in the library the interface for digital material, and shifting the desktop computer to pervasive computing systems. The approach taken is rather that new tools such as online library catalogues, electronic encyclopaedias, online databases, and digital libraries, bring together people and information [26]. New online services have emerged, such as the International Children’s Digital Library [26] that supports children in browsing rather than using keyword-based searches, and the “sociable digital library book”, a digital application offering readers the opportunity to leave notes and marks in a digital books and to share these with others [18]. Even though these projects are digital, they still support the traditional approach of one user, one computer, in spite of the fact that findings point towards the overall advantages of physical environments (augmented or not) over desktop environments for facilitating active learning [24] [11].

An example of striving to bring attention to the digital material in the physical library space, is the InfoGallery; a web-based infrastructure for enriching the physical library space with informative art “exhibitions” of digital library material and relevant information such as RSS news streams, event announcements etc [15]. A project focusing on the social and physical aspects of the library is the iFloor; an interactive Q&A floor prototype that supports and stimulates community interaction between collocated people at a municipality library [19]. A shared cursor is used to navigate the posted messages, and in order to support community and informal interpersonal interactions in the library the iFloor encourages users to collaborate and negotiate when interacting with the cursor and browsing questions.

In the Scandinavian countries, many libraries are adopting digital technologies for library purposes. Increasingly, libraries use RFID-technology and robots in place of traditional bar-codes for tracking books. The RFID [32] technology has proved a material for interaction design projects. An example of a library situated RFID-based project is AudioIndex; a mobile point-and-listen interface that allows visually impaired to browse and search for audio books within a public library without staff guidance [12].

## 3. A PRAGMATIST PERSPECTIVE ON PARTICIPATION

In the following section, we will outline a definition of participation that draws upon pragmatism and a social constructivist understanding of situated knowledge. The objective of this exercise is to clarify and substantiate our discussion about

the potentials for using interactive systems to cater for rewarding experiences through participation. With the scope and aim of this paper in mind, the perspective on participation that we present is particularly focused on the inter-relations between knowing and acting in a socio-cultural setting mediated by technology, and on the role that space and technology play in knowledge institutions. We will also bring into play the impact of visitors' prior knowledge and the history and character of the specific places for which we design participatory systems.

### 3.1 Pragmatism

Pragmatism is an umbrella term for a philosophical movement that, according to general consensus, was established by Charles Sanders Peirce, William James, and later on John Dewey. Though the work of these three originators share many common traits, they are not fully congruent [30], and even the term pragmatism was not accepted by them as a common label. It is, however, by this name that the movement is generally referred to today. We shall refer mainly to Deweyan pragmatism in this paper and clearly point out when we refer to other strains of pragmatism.

A central tenet of pragmatism is the assertion that the meaning and "truth" of ideas must be determined on the basis of their practical implications, a position often referred to as the primacy of practice. The world around us is in flux, according to Deweyan pragmatism, and our being in the world is characterized by forming ideas and theories as practical instruments for acting in it and aligning our environment with our intentions, which in turn shape our intentions and conceptions in the first place. Just as we are situated in the world and bring along with us our history of experience and habits, so is our environment, including places and technologies, shaped by prior events and people acting in the world.

The pragmatist perspective is familiar in parts of the design community and has inspired, among other things, Schön's studies of the reflective design process [29] and McCarthy and Wright's view on "technology as experience" [22].

In this paper, we employ pragmatist insights to formulate an understanding of engaged participation in knowledge institutions. Deweyan pragmatism presents an interesting foundation to this endeavour, since it is at its core a perspective on the reciprocal process of knowing and doing through processes of in-situ inquiry and experimentation [3]. The pragmatist perspective is intimately concerned with our processes of gaining knowledge about the world through forming, trying out, and transforming conceptions and theories through practice-based action.

In the following, we shall briefly introduce five key aspects of pragmatism - experience, inquiry, situation, knowledge, and space and technology - in order to establish a working definition of participation.

#### 3.1.1 Experience

Dewey distinguishes between two types of experience: 1) continuous experience, the ongoing flow of impressions of being in the world, and 2) an experience, a distinct encounter or event that stands out on the background of continuous experience, often because we perceive it as particularly fulfilling - an aesthetic experience - or particularly troublesome - an indeterminate or problematic experience.

Experience, both continuous and distinct, is situated and embodied in practice. First, this ties experience to our prior and

future personal histories, for "every experience both takes up something from those which have gone before and modifies in some way the quality of those which come after." [5]. Second, it disposes of the mind-body dualism and emphasizes that our experience is a feature of our bodies as well as in our minds, and that experience occurs in our simultaneous thinking about and acting in the world. Problematic experiences are those that challenge our pre-formed conceptualization of the world and require inquiry and action if they are to be overcome and transformed. Aesthetic experiences arise when past experience and present circumstances converge in a way that creates a sense of meaning and fulfillment. These two types of distinct experiences can be convergent since the process of overcoming a problematic experience can result in an aesthetic experience.

#### 3.1.2 Situation

To elaborate on the notion of situated experiences, the concept of situation in Deweyan terms is systemic and incorporates both the experiencing person as well as the physical environment (including artefacts, technologies and spaces, man-made or otherwise), socio-cultural norms and meanings, as well as other people whose intentions and actions may influence the situation:

"What is designated by the word 'situation' is not a single object or event or set of events. For we never experience nor form judgments about objects and events in isolation, but only in connection with a contextual whole. This latter is what is called a 'situation'." [3, p. 72]

As such, when we have problematic experiences, it is in fact because we are in a situation that does not fit into our habitual conception of the world, and thus we will often strive to bring it into a state that we can understand or control

#### 3.1.3 Inquiry

Inquiry is the particular mode of endeavour that we undertake when trying to resolve problematic situations, most comprehensively explained by Dewey in [6]:

"Inquiry is the controlled or directed transformation of an indeterminate situation into one that is so determinate in its constituents distinctions and relations as to convert the elements of the original situation into a unified whole (...) Situations are an intimate, interconnected functional relation involving the inquirer and the environment. The resolution of a problematic situation may involve transforming the inquirer, the environment, and often both. The emphasis is on transformation." [6]

The process of inquiry can be understood as a series of events in which 1) we first recognize that a situation is in fact problematic, 2) we then form simultaneous thought experiments with and articulations to understand what it is that makes the situation problematic. These conceptualizations form the basis for 3) hypothesizing about how we may reconstruct or transform the situation and 4) evaluating which actions may best help us resolve the situation before 5) we act in the world to find out if the hypotheses have the desired outcome. This is not a strictly linear process as the steps are often intertwined and the distinctions between them are analytical; often, we will not be able to identify the steps as such until after we have acted.

#### 3.1.4 Knowledge

The process of inquiry outlined here also serves to illustrate that knowledge in a pragmatist perspective is an active phenomenon that stems from our attempts to effectuate changes through

experimental action in a contingent world. Given that knowledge comes from experimenting in the world, knowers must be active agents in it. Dewey was thus radically opposed to what he labeled the spectator theory of knowledge. The spectator theory broadly regards knowing as a kind of passive observing, and knowledge as something outside of the observer that can be acquired through this observation. On the opposite, knowledge in a pragmatist perspective is an active process of interaction in which an agent enters into a transformative relationship with the environment in to form conceptualizations about indeterminate situations in order to predict and potentially control future experiences [4].

Given that knowledge grows from inquiry, pragmatism disposes also of the theory-practice dualism and proposes instead an experimental theory of knowledge in which building knowledge is a process of participation. Rorty, a present-day pragmatist, thus proposes that:

“[we should not] view knowledge as a matter of getting reality right, but as a matter of acquiring habits of action for coping with reality”. [27]

Summing up, knowing and doing are intertwined, and knowledge is about the change that we can bring about in the world through active participation.

### 3.1.5 Space and technology

Spaces and technologies are categories of particular interest to interaction designers, for these are the things that we shape through design. When making sense of and acting in situations, the spaces and technologies around us play a dual role: They are at once constitutive of our experience - in that they frame and shape it - and a means of altering experience - in that we may employ them in processes of knowing and doing. And just as we are situated and carry with us past histories and potential future trajectories, so do spaces and technologies: They are crystallizations of prior practice and bear with them affordances and potentials for future events. In a pragmatist understanding, spaces and technologies share a “dual conceptual-material nature” as stated by Miettinen in [23].

With regards to inquiry and knowledge building, spaces and technologies are resources in the situation that may serve as tools for inquiry. Gedenryd [13] uses the term situating strategies to denominate the strategies that we employ when we make use of these resources to help us to get to the future situation of use in the process. In knowledge institutions, this frames the role of spaces and objects as potential scaffolding for supporting visitors’ interaction with the subject matter in knowledge building. Spaces and technologies are often shared in socio-cultural settings, and Exploring the implications of Deweyan pragmatism within technology-mediated learning, Roschelle defines a specific category of technologies that supports joint knowledge building, namely collaborative technologies:

“A collaborative technology is a tool that enables individuals to jointly engage in active production of shared knowledge (...) Shared practices of collaborative technology use builds communal understandings.” [28]

## 3.2 A working definition of participation

Combining the key aspects outlined above with our understanding of knowledge institutions, we arrive at a working definition of participation in knowledge institutions:

*We define participation as (co-)exploring, (co-)constructing and (co-)contributing to the place as a resource for knowledge. By the place as a resource, we refer to both the social practice of the place as well as the pool of knowledge for which the place serves as a repository.*

In this perspective, participation is a mutual relationship in which the visitor in a knowledge institution encounters a specific framing of his or her experience and inquiry and gives something to the place through her actions. This contribution may be understood in a very literal sense, e.g. writing a shared review of a book in a library, or it may have to do with enriching the place through engaged interaction, e.g. through participating in an experiment in a science centre.

Some or all of the dimensions of participation may be present in a given setting and, as such, we may refer to knowledge institutions that stimulate participation to various degrees. We will do so for the cases analyzed in the remainder of this paper in light of the way in which the setting scaffolds exploration, construction and contribution to the institution as a resource for knowledge.

## 4. DESIGN CASES

Presented below are four cases from public knowledge institutions. The first is the exhibition at the viking ship museum in Oslo (Vikingskipshuset). Our second case concerns the Hydrosopes at the Kattegat Marine Centre, an aquarium and science centre in Denmark. Our final two cases are the StorySurfer and the BibPhone from the municipal library of Aarhus (the StorySurfer and the BibPhone). We chose to focus on the specific cases as they are examples of different degrees of participation in our pragmatist perspective, meaning (co-)exploring, (co-)constructing and (co-)contributing to the place as a resource for knowledge, roughly sketched in figure 1 below.

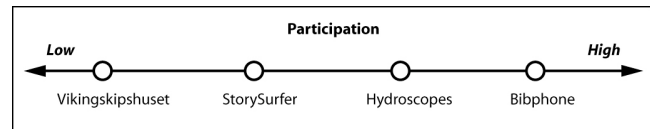


Figure 1: Participation in our four design cases.

The cases will be used as a base for further discussion and design considerations when designing for participation in public knowledge institutions.

### 4.1 Case: Vikingskipshuset

With around 400.000 visitors each year, Vikingskipshuset is among the most popular museums in Norway. The authors have done a number of preliminary studies, including extensive observations and interviews with visitors and curators, in preparation for developing interactive installations for the museum, and the analysis offered here stems from these studies.

The predominant part of the exhibition consists of the reconstructed ships that fill the centre of the exhibition space. The boats have been reconstructed based on the original finds and interpretations of how the Viking ships are believed to have been constructed. The museum is a socio-cultural icon of Norwegian heritage, and this institutional identity of Vikingskipshuset is to some extent mirrored in the layout of the museum. The museum itself resembles a church with a classical cross-shaped building housing a single room with white stonewalls and a high ceiling. The decoration of the room is minimal; the reconstructed ships are positioned centrally in the room allowing for visitors to pass on

each side of the ships (see figure 2). At the far end of the museum is a collection of artifacts displayed in classical montres. This striking layout of the museum seems to install a certain sense of awe as visitors are presented with this somewhat solemn setting. The reconstructed ships are guarded by a fence clearly indicating that the ships are not to be touched. This style of exhibition is found throughout the museum. An obvious reason for this is of course that the exhibited items do not take well to years of human touch. In light of the recent developments in museum exhibition design, it is however striking that the museum has chosen to maintain this traditional approach to presenting the exhibition.



Figure 2: The interior layout of the Vikingskipshuset

#### 4.1.1 Participation in Vikingskipshuset

The museum offers very little scaffolding for visitor participation. A striking and recurring observation made during our fieldwork was the amount and nature of the photographic practice going on at the museum. The vast majority of the visitors were taking pictures of the exhibited items and their friends or family accompanying them on their visit. The Vikingskipshuset museum offers little text about the exhibited materials, and it offers no opportunity to touch and thus experience in close the materiality of the ships, and neither does it offer any way of physically interacting. So we will suggest that, since no other means of participation are offered, photography provides an alternative way of appreciating the exhibition as the very practice of staging and taking a picture can be seen as an attempt to engage in the subject matter of the museum.

Visitors may explore the museum, although in a very structured manner, but with the possible exception of photography, they have no socio-culturally accepted way of constructing or contributing to the museum as a resource for knowledge; the museum is exactly the same when visitors leave as when they arrive. This is not to say that the museum fails in its current form. The museum seems to have achieved a very coherent exhibition concept in which great attention is paid to the materiality of the ships and their importance in Norwegian culture. Rather we will suggest that the idea of participative museum interactivity presents a new mode of conceiving the relation between the museum and its audience that may well complement the existing. We also speculate that doing so may help visitors better make inquiries into both the historical facts about what archaeological artefacts have actually been found, and how the process of reconstructing the ships has taken place.

## 4.2 Case: The Kattegat Marine Centre

The context of our second case is a research project exploring how digital technologies can be designed to create new ways of

engaging with museums and science centres (IXP). The setting of our case is the Kattegat Marine Centre (KMC) in Denmark; a marine centre displaying fish and marine life from all over the world. The centre consists of a large exhibition space where a myriad of aquaria create colourful scenery for visitors to explore life in the sea. The various aquaria are supplemented by boards with text and illustrations that provide visitors with information about the origins and characteristics of the different species. The culmination of our research efforts at the Kattegat Centre was the evaluation of an assembly of interactive installations designed to embody the idea of creating new ways of engaging with the exhibition space. In the following sections we briefly present these prototypes and discuss their participatory qualities as they emerged during the evaluation.

#### 4.2.1 Constructing and exploring at KMC

The prototypes built at the Kattegat Centre allow visitors to create their own species of fish by combining pieces from a physical construction kit containing a variety of heads, bodies, tails and fins from existing species of fish. The parts of the construction kit are created from acrylic and have an embedded RFID tag that give each piece a unique identity. A table with a rounded display in the middle set the stage for visitors to create their own fish (figure 3 left). Three RFID antennas are embedded in the table surface and invites visitors to experiment with various combinations from the construction kit. As the visitors construct their fish, the screen in the centre of the table shows a digital representation of the fish and provides simple information about the specific parts being used and the overall characteristics of the emerging fish (strength, speed etc.). Having created a fish, visitors can release the fish into a digital ocean where it will live with the other fish that previous visitors have created. Depending on the characteristics of the fish, it will inhabit specific places in the sea (shallow water, deep water, etc.). The digital ocean is mapped onto the physical floor surface of the exhibition space. The only way to explore the ocean is through the use of digital hydrosopes that can be pushed around the floor (figure 3, right).



Figure 3 – Visitors constructing fish using RFID construction kit (left) and exploring the digital ocean with the Hydrosopes (right).

As the hydrosopes are moved around the floor, the scenery in the hydrosopes change, building a metaphor of an ocean beneath the floor surface (see [7] for elaborate description).

#### 4.2.2 Participation at KMC

The prototypes at the Kattgat Centre were evaluated two times, each spanning a four-day period. Between the first and the second evaluation, minor changes were made to the prototypes mainly involving stabilizing software and hardware features. The evaluation consisted of observation (documented through video, pictures, and notes), informal conversation with the visitors as well as semi-structured interviews.

The presentation of the prototypes in the previous section provided a somewhat linear idea of the prototypes; visitors build a fish, release it into the ocean, and explore the ocean using the hydrosopes. During periods of evaluation the situation turned out to be much more rich than this. Visitors employed a range of strategies when meeting the prototypes in the exhibition space. The hydrosopes provided the most immediate way of engaging as the idea of pushing these around the floor works intuitively and provides a very visible feedback. The assembly table does not have quite the same intuitive use. Often visitors would observe others using the table before trying it out for themselves. The visitors who spent time at the installations often indulged in what may be characterized as a process of experimentation that involved moving between the hydrosopes and the assembly table. Having found an interesting fish in the hydroscope, visitors would find inspiration to create an entirely new form of fish and release this into the ocean. As such, the use very much progressed as iterations on building and exploring. In some instances groups of visitors would collaborate; one visitor exploring the ocean in the hydroscope while talking and exchanging ideas with a visitor by the assembly table. Moreover, visitors would attempt to re-create fish that they had seen in the hydroscope. These forms of engaging may be understood as the range of situating strategies employed by visitors when exploring the installations.

In term of participation, the prototypes highlight both the idea of experiencing the contributions made by other visitors in the form of imaginary fish and the idea of visitors themselves contributing to the place. The contributions are not in the form of formal knowledge but of the ideas and imagination embedded in fish. When other visitors find these fish in the hydrosopes, the fish do not fully reveal their individual parts. Rather, visitors have to re-create the fish and thus in some sense reproduce the ideas imbedded in the original. Moreover, visitors are invited to be part of the meaning-making process in a very literal sense as they are free to experiment with the characteristics of fish. The prototypes do not provide any correct answer; there is no correct fish to be assembled. The assembly table does however provide feedback relating to the properties of the various fish parts and their combination. As such, the prototypes frame the knowledge production.

Beyond the level of participation that is manifested in the creations made by the visitors, there is also a level of the discourse that the prototypes fostered. As the prototypes frame an experimental approach to the exhibition they incite visitors discuss the issue of fish and their characteristics. During our evaluation, this discussion did mostly evolve between visitors that had come the marine centre together. Instances where the discussion and dialogue moved between visitors that did not know each other were relatively few. As the installation typically engaged several groups of users the discussions where however shared among the visitors as a form of eavesdropping. Moreover, the rounded form of both the assembly table and the hydrosopes invited visitors to have a peek at each other's creations.

### 4.3 Case: The Interactive Children's Library

Our third case is the experiences and findings from two prototypes developed in a project entitled The Interactive Children's Library; StorySurfer [8] an interactive physical installation for book browsing within children's libraries, and BibPhone [20] which enables children to annotate physical material with digital recordings. The Interactive Children's Library was a research project carried out in collaboration with the Municipality Library in Aarhus, and several private companies. The project focus on the development of Pervasive Computing technologies and how they might be embedded in the physical spaces and environments of the children's library, to have the physical space and artifacts in the library become the interface for digital material. A detailed reflection on the entire design process is presented in [10].

#### 4.4 Prototype: StorySurfer

StorySurfer is an interactive inspiration browser enabling children to explore inspiration from library materials in an untraditional way (figure 4). The floor application displaying book covers is evoked by stepping on buttons on the edge of the floor. Each button is associated with a keyword. Hitting a keyword button will evoke a cloud-like shape on the floor containing book covers associated to the selected keyword; overlapping clouds contain book covers associated with several keywords. A cover can be further examined by moving into the floor. Each person entering the floor is provided with a cursor in the shape of a "magnifying lens" oriented and positioned in front of the user turning towards the centre of the floor. The "lens" is controlled by the children's body movements. Keeping the lens icon still over a projected book cover causes it to enlarge for better inspection and maintaining the position even a bit longer will cause the image to move across the floor to an interactive table. At the table it is possible to examine the chosen books further, apart from the cover image. Book-objects on the table contain buttons to information on author, summary, related books, and access to a printer from where it is possible to print a slip of paper that contains directions to the shelf, the related meta information, and the cover image. The interaction on the floor and on the table both support multiple simultaneous users interacting trough their own cursor.



**Figure 4:** StorySufer A) Browsing for books on the floor, B) Inspecting books on the table.

##### 4.4.1 Participation in StorySurfer

Through two periods of approximately three weeks each, StorySurfer was exhibited and tested in a main municipality library, where it was possible to study it in actual use. StorySurfer became a supplement to existing search methods at the library; a social arena where different users contributed to each others explorations in a playful and experimental way and a new way to explore the functionality of the installation and the resources of the library. StorySurfer had a central position in the library, and the children were often in contact with the librarians when using it. StorySurfer became a new tool of communication between the

librarians and the children, as well as a new meeting place for children of varying ages.

StorySurfer evolved to be an installation where people did explorations together. There was a lot of communication taking place around the installation, but there was not a particularly high level of noise around the installation though. In the beginning there was a lot of communication about how to use the installation, and visitors would pass this knowledge on to others. There was also cooperation between parents and children, where the children would surf the floor for interesting books that the parents reads about on the table. When they had decided upon particular books, the parents would go out to find the books.

Though the potential for social interaction is high given that multiple users can interact simultaneously in the same system, there is not much physical contact. As the cursors (magnifying lenses) on the floor are individual, users tend to avoid going to close to each other to interfere with the other users' search and cursor. StorySurfer was designed to exploit the physical library space for supporting social interactions. However, the prototype acknowledges that users might want to be left alone while browsing books and that the social engagement must evolve from the participants in action. Browsing books within certain categories in public might feel embarrassing for some children. In the prototype, searching books on your own while serendipitously being able to follow what "the others" find interesting holds social aspects on a lower implicit level than direct social and physical contact, but still adds a layer of co-contribution to the interaction, as your actions have an impact on the others choices. It is worth noticing that this kind of looking over the shoulder is much harder in the traditional library layout, with bookshelves and only book backs visible.

StorySurfer mediates a new practice for children exploring the resources of the library as well as a new practice for the librarians in providing support for children in their search for information. Thus the librarians need to adopt the idea of alternative ways towards finding books and also new social and physical situations in which the dialogue between child and librarian can take place. Through StorySurfer, movement, stepping on buttons, pointing towards book covers on the floor as well as dissecting book objects on the table becomes part of a new shared practice between child and librarian.

The interaction with StorySurfer became to a large extent a social activity. To use it as a search tool was something the children did with their parents or friends, rarely alone. It was also a very physical activity, as the children moved around and explored the digital interface, and by using different tools and body movements they contributed to each others searches and explorations. StorySurfer was appealing to all ages, and the installation became a new social and interactive meeting place for children, teenagers and adults. Instead of dividing the library into different sections for different age groups and activities, StorySurfer creates a common ground for explorations.

#### 4.5 Prototype: BibPhone

The BibPhone prototype enables children to annotate physical material with digital recordings. Children are able to add oral comments to books by placing the BibPhone over a RFID tag on the book. Putting an ear to the book enables hearing the comments recorded by others. The concept originated from children's reluctance towards doing written reviews, and the fact that more and more libraries are adopting RFID technology on information

material. The BibPhone can be used for treasure hunting for messages in books or enabling children to have a secret information layer attached to selected books. Furthermore, the concept is not restrained to information materials but could also be used with regard to adding RFID tags to specific elements in the physical environment, enabling new forms of play and information exchange (figure 5).

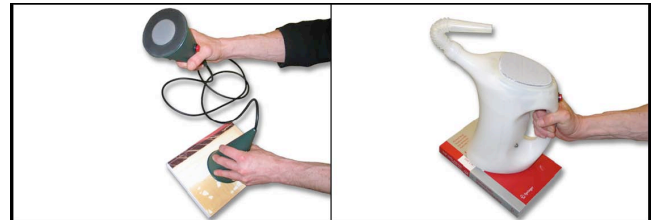


Figure 5: The two bibPhones and their different physical affordances.

##### 4.5.1 Participation in BibPhone

Two different BibPhone prototypes have been tested for two weeks in two different libraries. The objective of the first tests was to check the durability of the prototypes and further to see if the basic concept of adding sound to books was useful both in the sense of guiding children to books of their interest but also as an open infrastructure for the children to appropriate.

The librarians were fascinated by the new potential way of communicating with the children through the books and used a lot of time recording comments and reviews onto the books. Librarians are usually dependent on their memory when guiding children to a specific book or directing children to written reviews on the library website. Through the BibPhone, librarians can store their initial review of a book right after reading it for children to hear. To increase the amount of sounds on the books the librarians invited school classes to the library to record reviews of books they had read in school, and thereby contribute to the pool of sounds.

As the BibPhone was tested for a rather short period of time it is hard to say whether it would really become a parallel practice for investigating books along with regular browsing. Most children found it fun to use the BibPhone to listen to what others had recorded on the books, but making own recordings seemed to be embarrassing. This might be due to the awkward situation of talking to a book or the difference in privacy between writing a review and speaking it out loud. What we saw was that instead of selecting or rejecting books by looking at the cover image - as we observed during our initial field studies [9] - all books held potential interest, making the children go more systematically through the book shelves with the BibPhone.

No matter how fun or fascinating the BibPhone might seem it is a part of an open information system similar to the PhotoSwapper [9] and the iFloor [19] and thus only interesting if the system is filled with content produced by the users. It is strictly dependent on the contribution of other users adding content and thereby constructing the shared database.

## 5. DISCUSSION

### 5.1 Balancing the potentials of interactive participation and the sense of place

A very pertinent challenge to public knowledge institutions is the uncoupling of the information that these institutions are

traditionally thought to be repositories for, and the dissemination of this information through other channels, e.g. via the internet, thus reducing or ultimately removing the need for the institutions in their physical form. In our definition of participation, we have stressed that participation entails contributing to the place in which participation occurs. We will contend that while we may employ interactive technologies to support building and sharing knowledge, a key quality of many public knowledge institutions is that they are imbued with meaning, which is in part determined by and dependent on their physical presence in a community. Rather than seeking to employ interactive technologies to render physical presence of these institutions superfluous, as we may consider e.g. Library 2.0 to be a move towards, we will advocate design considerations that incorporate the qualities of places through their specific history of being meaningful, physical places in communities. We will use the notion of *genius loci* (Latin for “the spirit of the place”) to denote the distinctive character or atmosphere of a place. In a pragmatist perspective, we may understand *genius loci* as the amalgamation of shared socio-cultural meanings that are attributed to a specific place. For the three domains described above, we have identified a number of key characteristics of *genius loci* through our field studies and design work:

The most striking characteristics of the *genius loci* of Vikingskipshuset are 1) the sense of awe when faced with the reconstructed ships in the church-like building, 2) the experience of the ships as icons of Norwegian history situated in the capital of Norway, and 3) the materiality and tangibility of the wooden ships.

For the Kattgat Centre, the prime characteristics are that 1) the centre offers a glimpse into another world, 2) the sense of wonder through discovery that occurs when visitors explore the centre, and 3) the centre is home to living, interacting organisms.

The key characteristics of the *genius loci* of the Aarhus municipality library are that 1) it is first and foremost a home for books, 2) it is a place from which information flows out to the community, 3) that it is an open and inclusive social place.

In our design work, we have worked with these characteristics as resources for design in order to balance the interactive potentials for participation with the *genius loci* of the settings. With regards to Vikingskipshuset, we have not at this time arrived at a prototype. For this reason, we shall refrain from speculating about the specific materializations of the place-specific characteristics, save to say that they are key components in our conceptual design work. For the Kattgat Centre, the Hydrosopes are quite literally designed around the idea of peeping into another world, namely the ocean full of fish assembled by visitors. It is through active, physical exploration (by maneuvering the hydrosopes) that visitors discover the ways in which the fish live and interact in this virtual world beyond our own. StorySurfer is, on a functional level, intended to guide visitors towards books stored in the library. The strength of the installation, however, is that it acts as a conduit for social interaction, promoting and provoking interaction among visitors in exploring books, which when selected unfold to reveal further information. In the case of the BibPhone, the information generated by users are tied to the specific, physical books housed in the Aarhus municipal library. It is from these books that information flows to visitors, who are in turn provided with very open and accessible means for both accessing and contributing comments and reviews of books.

Participatory use of the prototypes, through processes of exploration, construction and contribution, are thus tied to the situated meanings ascribed to the institutions. Active use of the prototypes represent different ways of contributing to the specific places, rather than merely accessing information. These contributions occur both on the level of adding some sort of information, be it a review of a book or the shaping of a fish for other visitors to see, as well as on the level of engaging oneself in social interactions tied to the place, such as using the StorySurfer in collaboration with other visitors to explore books, or by piquing the curiosity of fellow library visitors by moving about the library while talking to books through the BibPhone.

## 5.2 Extending the functions of public knowledge institutions

As a part of exploring the information that the public knowledge institutions can provide it is important to not just design new functionality supporting exploration when introducing new technology, but to use the technology to support and further develop the basic functionality of the institution. Basic functionality can be defined by for instance searching for books in the library or learning about the background of an exhibited object in a museum. To support a basic function could for instance be to transform it from desktop interface to a spatial installation, introducing new ways of interaction. To further develop this function is to bring in elements of co-construction and co-contribution, to transform the institution from an information provider into a place for information exchange, as seen in the examples presented above. To involve elements of user co-construction and co-contribution into the exploration of public knowledge intuitions is to change from designing for information push into designing for information dialogue. As a part of supporting and further develop the basic functionality is further to investigate the hidden potentials in the place and use them as materials for design, and to join them in design proposals, such as the massive free information potential, the need of a meeting place, and the existing technologies in the institution. StorySurfer affords activity and functionality that goes beyond the console games and browsing books on the internet that does not differentiate the library from most children’s homes. The fact that children returned several times shows that the prototype had an impact in adding focus to the physical space as well as supporting the basic function searching for books. Interacting with StorySurfer involves elements of exploration in investigating the resources of the library while searching for inspiration. Interacting with StorySurfer also involves elements of co-contribution, to the library environment and to the other users in that they can be inspired by your choices. Co-construction is essential when building a pool of interesting books at the table, and also when choosing categories on the floor. Without the users acting, StorySurfer is nothing more than a floor and a table, perhaps a stage, but the users’ interaction is essential. Even more dependant on the contribution of others is the Bibphone, as users actually construct the content. Without this contribution, it would just be an empty infrastructure and not tempting to use for exploration of the library resources.

Beyond utilities to support activities such as searching and reading information for individual visitors, the public knowledge institutions must support dynamic and sociable functions. The libraries must for instance support functions such as annotating, reviewing and sharing materials, functions that visitors construct



and that contribute to the library resources, such as in Library 2.0 or BibPhone. The museums must involve the visitors in work of constructive nature and make them contribute to the resources of the museum to enhance their understanding, for instance by offering paint workshops for children at art museums, joint science experiments, or installations such as Hydrosopes in science museums.

Vikingskipshuset is successful in providing traditional museum functions, such as exhibiting objects, but lack in providing further information and the history about the objects, and has almost completely excluded the visitor from any form of participation. The Kattegat Centre is also successful in exhibiting its resources and supports the visitor in participating to a higher extent, by for instance demonstrating feeding of the fish and the possibility of touching some of them. The centre lacks in taking the visitor from explorer up to (co-) contributor and (co-)constructor. As it is now, the users' actions do not give anything to the place. At the municipal library traditional activities such as borrowing materials and reading books are well supported, and even though it is still regarded as side-activities the library has introduced computers equipped with games, to facilitate people just being there for the entertainment and as a social setting. There is an increasing awareness and acceptance that noisy elements such as game playing and hanging out, are important elements in what a library should offer, even though the main part of visitor participation is taking place online, through websites and Library 2.0.

## 6. CONCLUSIONS AND DESIGN CONSIDERATIONS

Throughout this paper, we have outlined and explored some of the challenges facing designers of interactive technologies for public knowledge institutions such as museums, libraries and science centres. Our engagement in experimental design work in these institutions have led us to argue that participation is a key concern for the fruitful integration of interactive technologies into these settings. We have developed an understanding of participation founded in pragmatism, which highlights the reciprocal relations between visitor engagement, institutional history, and the development of knowledge and place-specific practices. Using this perspective, we have examined four different set-ups which exhibit varying degrees of participation: In the one end of the spectrum is Vikingskipshuset, which can be construed as a representative of traditional, non-participatory exhibition design; StorySurfer, which promotes visitor co-exploration and the development of new situated, social practices; the Hydrosopes that combine co-exploration and co-construction with a certain degree of visitor-generated content contribution; and BibPhone, which allows for free-form visitor-generated content as an extra layer of information coupled to the physical library.

On the basis of our explorations presented in this paper, we will sum up our work in six design considerations, which may serve as guiding principles for fellow interaction designers venturing into the domain of public knowledge institutions:

Respect the sense of place – Public knowledge institutions are rooted in communities and through their dual conceptual-material nature they embody shared socio-cultural meanings and practices. These meanings and practices, along with the existing physical structures, are resources for design.

Create common grounds – Public knowledge institutions are hubs for new encounters; the presence of a multiplicity of visitors

with varying backgrounds and intentions are a further resource for design, and enabling and supporting shared interaction, their emergent behaviour may contribute to the development of fruitful social practices in the institution.

Support and extend traditional functionality – Explore ways of augmenting and extending the traditional functions of the institutions (rather than introducing playful but disjointed installations). This will tie into both the existing practices in the institution and visitors' prior knowledge and experience of the place.

Promote engagement through inquiry and exploration – Knowledge grows from inquisitive exploration, and institutions can scaffold these processes by framing intriguing situations and providing means for exploring them.

Encourage participation through construction and contribution – Knowledge stems from the transformation of an indeterminate situation into a an understandable one, and this process often necessitates active involvement in processes of construction and contribution. This emphasizes the potential of dialogical systems that encourages visitor input; this may also further social interactions.

Enable multimodal participation – Visitors build knowledge through all of their senses and are capable of employing situating strategies to do so if provided the means in the situation; supplement the disposition towards visual interfaces with multi-sensorial and multi-modal ones.

These design considerations may be used in different ways, and at different stages of the design process: They may support analyses of existing public knowledge institution, serve as inspiration for design concepts, guide design moves in actual development work, or frame evaluation.

Designing for public knowledge institutions is a complex affair. Our work, as evidenced by the cases, places a high emphasis on the genius loci of established, communal institutions. This does not mean that we discourage or discard of the idea of extending the reach of public knowledge institutions through the use of e.g. Web 2.0 technologies, but we argue that such moves should supplement rather than supplant the physical institutions.

## 7. ACKNOWLEDGMENTS

This research has been funded by Center for Interactive Spaces (the IXP project and the Interactive Children's Library project) and we thank our colleagues and the project partners for their support. Moreover, we thank the staff and guest at the numerous libraries and museum for their enthusiastic participation. In particular we would like to thank Terje Planke and Dagny Stuedahl for inviting us to work with Vikingskipshuset and for inspiring discussions on participation in exhibition spaces.

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