Case studies: technology enhanced public spaces for intergenerational learning

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D38.3.1 (Final)

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Summary

This deliverable undertakes the analysis of four case studies in the three key dimensions of La Piazza: intergenerational learning, ICT and physical spaces. The report shows the common characteristics of the cases, good practices as well as issues for further research, in order to facilitate the planning of the co-design seminars, that will follow next in the project. The report includes in the Annexes the individual case reports of the cases.

History

Filename	Status	Release	Changes	Uploaded
D38-03-01-F.pdf	Final	1		17/08/2006
	Draft	1		01/01/1970

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Contents

1. Introduction

The objective of the "La Piazza" project stems from the need to enrich current views on collaborative technology enhanced public spaces for informal learning, such as Computer Clubhouses and other similar community centres, as well as museums, and civic networks catering to the social integration of adults and youths. "La Piazza" achieves this objective by setting a scientifically sound and socially relevant basis for researching and further developing two key dimensions that are still problematic and unexplored by current research and practice:

1. Intergenerational learning scenarios supported by technology in public social spaces, where learning takes place indirectly, across ages, through meaningful social interactions.

2. Ecological integration of digital tools and interfaces in the physical architecture of those public spaces, to support meaningful and playful intergenerational activities, conducive to learning.

Up to now, the project has centred mainly on a review of literature and state of the art to flesh out key concepts and lay out a theoretical framework (ex: intergenerational learning, contexts and places of learning, reciprocity, media). The second focus has been the methodology used in the case studies we conducted in five informal public education spaces—all of which deal, directly or indirectly, with intergenerational learning aided by ITC.

This report highlights some of the common features that emerge from these studies, and identifies problematic aspects as well as good practices in order to facilitate the process of making future work plans. To this end, we focus on we build upon the conclusions of the previous report, which presents five common dimensions of relevance in each of the spaces studied.

2. Context of the study

2.1 Decisions for selecting the cases

Three basic dimensions were taken into account for selecting the case studies: **Technologies**, **Intergenerational learning** and **Physical Spaces.**

- Technologies: Although existing TEL public spaces usually foresee an active role for adults as mentors, their philosophy is still mostly that adults should be there to provide support and scaffolding to the young people, and/or ensure the maintenance of the technological infrastructure. In contrast, our main idea is that the community centres can – and should - promote intergenerational social ties and societal learning by encouraging mutual learning between adults and the young. It is our assumption that both adults and youth are legitimate producers of knowledge and culture.

- Intergenerational learning: The growing importance of intergenerational learning is stressed, on one hand, by policy documents as a response to demographic trends (and

a growing need to integrate the aging population through life-long learning strategies) On the other hand, research has explored the benefits derived by adults and youths involved in intergenerational learning experiences. What is yet largely unexplored to this day is the role that technology enhanced public spaces can play in maximizing those benefits, by enhancing creative expression, collaborative problem-solving, richer environments, learning in multi-dimensional spaces (physical and virtual), etc.

Physical spaces: Finally, learning activities do not happen in a spatial void. Physical spaces, like technology itself, are extensions and depositories of human experience. Both mediate human experience, thus conditioning human activities and identity, and both signal affordances through often unrecognisable and implicit codes that are nevertheless perceived and interpreted by people. Like any other language, space is a constitutive element of thinking and knowledge construction. This is why it is important to conceive of, and design, built spaces that are sensorially rich and stimulating (light, colours, smell, touch etc.), as these qualities affect the learning process.

While in all the proposed sites the previously established characteristics are generally relevant,. the case studies have shown essential in determining how – and to what extent - these dimensions are working in each space.

2.2 Outline of the sites

Each case study must be understood from its unique perspective. As well as finding common threads, we can see from the diversity of contexts that each site has its own characteristics and problematic areas. A full description of the case studies is found in annex II. Following is a brief description of each of the sites.

MAMAC

The MAMAC, Museum of Modern and Contemporary Art, is the biggest museum in Liège. It is situated in the former *palais des beaux-arts*, a building of the World Expo of 1905, in a remarkable park in the heart of the city of Liège.

The museum is divided into two areas that change over time. The first is dedicated to the exhibition of the permanent collections —paintings and sculptures from 1850 to the present. The second part is dedicated to temporary thematic exhibitions that last from one to three months. The themes vary: specific artists, countries, particular places, etc. These two areas occupy the whole space of the museum and their arrangement changes frequently.

There is another museum, the *cabinet des estampes et dessins* (museum of engraving and drawings) in the basement of the building.

The MAMAC is also a central point for the network of a part of cultural life in the region. Many non-profit associations, working in different areas of artistic and cultural projects, are in some ways linked to the museum. It is a kind of window for many projects, offering a prestigious large space of exhibitions.

COSMOCAIXA

CosmoCaixa is a centre for promoting science in Barcelona. The key objective of the interactive museum is *to popularize scientific knowledge for people of all ages, to*

evoke sensitivity and feeling in the visitor who wants to learn. Its participative and educational methodology is based on interactive experimentation; from a series of exhibition models that the visitor can manipulate and follow according to guidelines, scientific principles can be concluded.

This interest in popularizing science is manifest throughout the centre. The museum is open to everyone. We can find proof of this in the inexpensive offerings of the institution as well as the great variety of activities designed to attract the greatest possible number of people with different intellectual and educational levels.

Physically, the museum occupies a space of 50,000 square metres covering five floors. This space is divided into two types:

- Permanent spaces
- Travelling Exhibitions

CosmoCaixa is technologically oriented by definition. All exhibitions, activities, and spaces follow the scientific method and direct experimentation. In many cases the experimentation must be virtualised through the use of technology, such as video, radio, digital systems, and computer programs.

CosmoCaixa has opened a new public square for the city of Barcelona, a large esplanade of over 5,000 square metres for enjoying the environment and science. In the near future interactive models will be installed—sculptures, machines, and experimental structures for discovering and understanding the elements of nature scientifically. This space is totally free during museum hours. The activities developed there are open to everyone and, through them, the goal is to strengthen relationships between citizens and to sensitize everyone to science in a totally playful atmosphere. Some of the activities have been: animated scientific shows, trips in hot air balloons, open-air cinema, and giant chess days for children.

The pedagogic concept of *CosmoCaixa* is based on working with the largest, most varied public possible. For this, the museum gives visitors the opportunity for different learning paths and complementary activities in order to optimize the fulfilling of the centre's objectives to popularize, sensitize, and raise awareness of science.

COMPUTER CLUB HOUSE

The Computer Clubhouse in Viborg, Denmark, (**CC Viborg** in the text to follow), is a member of the international Computer Clubhouse network. It is a result of the cooperation between Learning Lab Denmark (part of Danish University of Education, DPU, based in Copenhagen) and the town of Viborg.

Viborg has approximately 43,000 inhabitants and is located in central Jutland, Denmark. It is the seat of both Viborg municipality and Region Midtjylland, one of the five regions in Denmark. About 10,000 of its inhabitants are younger than 18 years old, and approximately 4.8% among the young come from immigrant families.

CC Viborg is not unlike many other computer clubhouses of its kind, but it also has some specifically Danish characteristics. Contrary to other CC, it is not sponsored by Intel, but by the local Commune. It is oriented towards all young people, not only the

socially excluded. It also provides environment and equipment for school-based week-long group projects. Mentors are from different backgrounds, from people with multimedia and programming skills to those with pedagogical skills. Lastly, the model of working honours exchanges of experiences between youth and mentors beyond classical mentoring.

Existing Computer Club Houses serve as exciting environments for research, too. For example, in April 2004, the IT-Center Viborg concluded a research project SAFT (Safety ,Awareness, Facts and Tools) in cooperation with Viborg Computer Club House. The research project explored how young people use the Internet, and what the parents know about their children using the Internet. The results of this project were disseminated in several conferences, but also in direct meetings with parents.

SIGNPOST

The Space Signpost project is an attempt to develop a new approach to public understanding of science that empowers individuals to explore questions and ideas of interest to them about the solar system. The prototype is an experiment intended to discover what sorts of representational systems can encourage users to confidently explore questions of science and discover answers for themselves.

The installation itself consists of a representation of the solar system with a moving signpost linked to a digital touch-screen. The signpost moves to point to an object of the user's choice within the solar system and displays the distance to that object on an LED screen on the sign. The digital touch-screen provides further information about this object, and offers users a range of different options for interacting with three-dimensional representations of objects within the solar system. The installation is designed to be located in an outdoor public space likely to be affiliated with a public institution (for example outside science centres or galleries) and to be usable by the full range of the public, with appropriate accessibility for individuals with physical disabilities. The installation can be described as a cross between street theatre, street furniture, installation art and science centre exhibit.

The over-arching aims of Signpost are:

- To empower users to conceive of astronomy not as a domain, both literally and conceptually, 'out there' (either in 'outer space' or in the scientific arena) but as a domain within which we live and breathe.
- To facilitate confident engagement with scientific representations that can be interrogated by individuals in the ways they interrogate and interpret the signs and symbol systems of their local neighbourhood.

The Space Signpost (formally Welcome to the Neighbourhood) project consisted of two phases of development:

The technical development of the project was conducted in-house at Futurelab between Adam Nieman, the designer and concept artist, and Alex Burton, the programmer, a process that enabled close cross fertilisation of ideas between programmer, content developer and research and technical teams at Futurelab. It uses open source software, Celestia, and has involved the development of a flexible HTML interface to allow modular changes in further development.

3. Methodology for data analysis

The methodology of analysis of the cases has been deployed in two stages.

- Stage 1: A comparative analysis of the case study reports from which was taken significant descriptive information about the following characteristics:
- Context
- Main Goal
- Target Audience
- Physical Spaces
- Virtual Spaces
- ICT
- Intergenerational dimension

In addition, based on initial interviews performed with MAMAC cultural actors, preliminary key dimensions for successful intergenerational projects have been identified. These dimensions were first matched with issues described in the literature, then discussed with all partners, and finally refined and consolidated as a preliminary model that could be applied and generalised to all case studies. The key dimensions are the following:

- Space
- Time, Rhythm
- Identity/role
- Artistic expression
- Media
- Social connection
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Stage 2: A participative "focus group", in which, through a brainstorming session, the project partners gave their views on the most relevant characteristics of the case studies.

In addition to this ideation process, cases were then discussed and analysed against key dimensions, in order to identify which were more present in each case, with the aim to guide the co-design workshops to be held in June, and presented in the next work-package

4. Results

4.1. Key characteristics of the cases

The Table below shows some of the most relevant characteristics of the four cases studied. The Table considers the characteristics previously mentioned: Context, Main Goal, Target Audience, Physical Spaces, Virtual Spaces, ICT, and Intergenerational dimension.

Characteristics		Cases			
		CCHV	**MAMAC**	**COSMOCAIXA**	**SIGNPOST**
	Context	Well-established environment where people come and work with technology, mostly by themselves	Public Museum of Contemporary Art	Interactive museum. It's a centre for popularizing science	Combination of sculpture and multimedia in public spaces (squares, parks, etc.); this specific case is located in the main square in Bristol
	Main Goal	To increase public awareness of possibilities to use computers to create art and express oneself	To Popularize Contemporary Art	To popularize scientific knowledge for people of all ages, to evoke sensitivity and feeling in the visitor who wants to learn	To increase public awareness of the nature of our place in the solar system and the "all around us -ness" of space
	Target Audience	Youth 12-22 years old in Viborg, Denmark. CC Viborg has 117 members (30 come during a day)	The museum is open to everyone	The museum is open to everyone	Open to all visitors to Millennium Square

Physical Spaces	123 square-meters divided into six rooms in a reconverted Army training centre. CCViborg has a world-famous animated-movies school as a neighbour. It counts twelve computers, a music studio and a movie studio. It has one permanently employed leader and a varying numbers of volunteering mentors	It's the biggest museum in Liège. Situated in the former "palais des beaux-arts". It is divided in two areas, changing over time	The museum occupies a space of 50,000 square-metres covering five floors, distributed in ten permanent spaces, and three itinerant exhibitions, as well as a public square	Millennium Square in Bristol, as an open public space	
Virtual Spaces	Own web-site where members can publish their work International Computer Clubhouse web-portal where member's work could also be published	At the moment, this is not a priority for the museum	The website of the museum offers a virtual learning and exhibition space, named "Virtual Experiments", in which one can follow some of the activities of the centre On the website eight different activities are presented in a way the user can interact through virtual characters, stories, and simple games with some basic scientific concepts	Touch-screen interface technology	

I C T	CC Viborg needs to buy all the licenses for software tools they use. Since professional graphical software is very expensive, they use free software licenses whenever possible	ICTs are neither widespread in the museum nor in the activities we investigated for the case studies. Except for a website, there are no ICT structures for visitors New technologies are far more used in the artistic creation, as components of the art works In the intergenerational activities studied, there are almost no technologies	All exhibitions, activities, and spaces follow the scientific method and direct experimentation procedures. Many activities are virtualised through the use of technologies, such as video, radio, digital systems, and computer programs	**Celestia**: open source space simulation software Macromedia Flash and HTML LED display technology Touch-screen interface technology Custom control system	

| *Intergenerationality* | CC Houses are dedicated to young people, up to 18 years internationally, and up to 22 years in Denmark.

Even interactions between 12 - and 22 years olds can be marked as intergenerational.

Other intergenerational dimension: people of different ages and skills are engaged as mentors–varying from technically skilled persons to no pedagogical skills, from teachers to trainees. | • Inclusion of youth for the exhibition «biennium of photography» (March-April 2006 in Liège)

• Intergenerational animation activities for the promotion of a cultural centre in Belgium

• Artistic animations in schools and other organizations | They work with the largest and most varied public possible: the Museum can be enjoyed from age three on. Many activities are planned to be made by the whole family | The sculpture is in a public space, so the intergenerational aspect is directly related with the Bristol population |

Table 1. *Comparison of key Characteristics of the Case Studies*

4.2 Common characteristics

Once finished the comparative analysis of the case studies, and after concluding the focus group meeting, one can see that the dimensions proposed fit quite well the different case sites. *Annex I* shows the predominant dimensions of each case that came out of the Focus Group exercise.

Based on the results of the analysis, we observe a common approach across different sites. For instance, in all the sites, learning by doing and enjoyable learning are encouraged. In all the sites, space is used in ways that offer a safe elbow room for creative interactions.

4.2.1   *Physical spaces*

All the sites present similar physical characteristics: They are all public spaces, or spaces with easy access that are well defined and delimited. This physical demarcation mediates both learning and human transactions within a concrete environment.

- Example 1: Signpost is situated in the middle of a public square. Everybody can access it without restrictions. The concepts that the Signpost exhibits are abstract—universe, distance, the relation between the individual and his or her environment. The possibility to experience these concepts in space (a public square,) allows the user to imagine these abstract concepts associated to a concrete environment. This marriage makes the physical space a point of reference for learning. This characteristic is thought to facilitate users' understanding of abstract concepts. It is in these concrete places where one has the opportunity to learn in a free manner.
- Example 2: MAMAC offers visitors a possibility to work in creative workshops that occur in specific physical spaces. At the same time, spaces can be layered, i.e. they give the opportunity to show and share creations from previous learning experiences.
- Example 3: In the case of CosmoCaixa, free experimentation, or hands on activities, allows for a better understanding of many abstract concepts.

However, one space-related limitation that seems to run across most sites is that few of them encourage spontaneous production of new and autonomous knowledge by the participants, or they do it marginally. For example, in Signpost it would be possible for users to invent their own queries and to spatially record their experience for future visitors to experience. This issue is to be further explored in the co-design workpackage.

4.2.2   *Intergenerational dimension*

Intergenerational learning is understood in different ways across sites .

To some actors, intergerational learning happens naturally within families, so the purpose becomes to include families to any proposed activities. For a museum the aim is to attract as many people as possible, so families are taken into account in the design and organization of exhibits and other interactive activities.

To others, intergenerational learning occurs mostly through "show and tell", or when someone coaches, teaches, or transmits his knowledge or skills. This can be achieved

in workshops, laboratories, etc. Action is key here and so is personal involvement. The roles of the actors are different: coaches, teachers, tutors, masters, or simply, parents, apprentices, students, colleagues, sons, etc

In most cases, transmission is seen as a key to intergenerational learning. However, in most intergenerational dynamics a dimension of reciprocity appears, and is usually recognized. in other words, people know that they learn from each other and that everybody, young and old, benefits from engaging in mutual exchanges.

The cases all depart to a greater or lesser extent, from a position of respect for the learning background and learning desires. This characteristic is intrinsic to informal learning spaces: It values the learners' active role in learning: Freedom of choice of learning paths, spontaneous demands for the people to collaborate with each other, enjoy, create, experiment, dream on new realities, developing among them a sense of belonging as part of a group that works and learn together.

4.2.3 ICT

ICTs are present as learning resources in almost all the sites; They are intended to enrich the activities, making them more engaging; however, the potential of ITC could be further explored, and better exploited. Particularly in the case of MAMAC, where ICT is absent, its use could help at least to disseminate the learning activities offered by the museum (as in the case of CosmoCaixa), Possibly, the perception by the people in charge of museum activities at MAMAC is that ICT (as currently available on the market) does not satisfactorily promote creativity and integration.

In all the sites, innovative uses of ICT have fallen short of what could have been possible.

In the light of these observations, one main objective of La Piazza will be to further explore and promote a holistic approach in which ICT can be used to foster changes or supports new educational scenarios and new interactions among learners. In substance, our task ahead is to imagine and design optimal ICT usages to: 1. help the users reflect on the nature of what they experience; 2. enrich the spatial dimensions of the sites combining the physical with the virtual dimensions; 3. increase the potential for expression and creation of participants, and finally 4. to facilitate the access to contents as well as the communication among the members of the learning.

In sum, a ludic approach to learning is commonly valued in all sites. As Davis, Larkin and Graves (2002) said:

> *"(…) play is universal, and thus a good way for all to learn about themselves and the world. Shared play experiences are important in building mutually beneficial relationships among younger and older generations, and they contribute to cognitive growth, improved social skills, physical development and emotional wellbeing"*[1].

In the context of inter-generational learning, ITC needs to be customized, configured and used to promote the playful aspects of learning. ITC should be made appealing to

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[1] Davis, L., Larkin, E. & Graves, S. (2002). Intergenerational play and learning. International Journal of Early Childhood, 34(2), 42-49.

players involved by offering different possibilities for creating new environments, new experiences and new ways to enjoy the reality. However this characteristic has not yet been fully exploited in our public spaces.

4.3 Critical traits and integration

Although the general characteristics of the sites are similar (as mentioned in the previous section), after analysis, we considered it opportune to manage the critical aspects differentially. This decision not only honours each site's unique conditions and contribution but favours the co-creation of plural concepts that, in the future, can be generalised to design or improve many informal educational public spaces.

 Each site presents the following critical points:

At **MAMAC**, the actors don't use ICT for developing their activities, nor do they have the intention of using it in the future. This may depend on their perception of ICT. Working in la Piazza could open up new opportunities to the museum, and their approach could bring new perspectives on the design of new ICT affordances.

This case is particularly interesting as the intergenerational work in the museum is very strong. Many of the practices (described in the annexed case study), can be considered as work models. They take full advantage of the inter-generational learning dimension.

At CosmoCaixa the actors make use of ICTs for providing rich learning spaces. However, it seems that the intergenerational dimension is a by-product of the general objectives of the museum, and not part of a specific plan. It is for this reason that we have not yet found a strong interconnection between the intergenerational approach, the learning scenarios and ICT in this context.

On the other hand, the strong points of this interactive museum is the innovation on the presentation of contents, the experiential learning approach, the possibility to combine guided learning activities with a rich and stimulating informal space and the use of ICT-based virtual spaces. All these aspects could be supportive of the intergenerational learning experiences. Furthermore, these dimensions could be better exploited and integrated in the future.

At **CCHV**, two aspects emerge as working priorities:

- How to attract new members and keep the regulars in spite of strong competition with a lot of leisure activities available elsewhere: sports, after-school work and other activities Danish children are typically involved in.

- How to recruit and motivate enough skilful mentors. In Denmark it is not usual for persons with high-tech skills to engage in volunteer work—they usually demand (and get) high salaries.

A very strong point of this site is its didactic use of ICT. In their work, the actors achieve a good balance between ICT as resource and as pedagogical tool. A first conclusion from our case study is that they have created activities with these resources that have stronger teaching power than they could have created without them.

Signpost, finally, provides an excellent example of an informal learning space. The ability to include all the public offers very interesting possibilities. The main challenge we face is that of converting "Signpost" into a steady "meeting point" for intergenerational exchanges.

5. Next Steps: Issues to take into account in the co-design process

The dimensions of future work may vary in each case.

	Key Dimensions					
	Intergenera-tional	Space	Pedagogical	Media	Time	Artistic
MAMAC	+	+	+	-	+	+
COSMOCAIXA	+	+	+	+		+
CCHV	+	-	-	+	-	
SINGPOST	+	+	-	+		

Table 2: *comparison of key dimensions in the cases. The sign "+" shows a positive level of the stated dimension in each specific case and "—" for indicating improvement for the future. A blank cell indicates no relevance.*

This table (2) highlights the strong and weak dimensions in each public space. The white spaces indicate the lack of the stated dimension in the space in question.

These outcomes will help the project guide future actions in the Co-design process, which will be undertaken in the next work-package. Aiming at improving the different spaces during the project' brainstorming exercise, different lines of action emerged. They will be proposed and discussed with each site and collectively in the first co-design workshop scheduled at the end of June 2006. Here we have the most important ones:

MAMAC

- Create the opportunities to bridge the artistic creation and the visiting activity, by sustaining the community in a whole intergenerational experience, taking care of the following dimensions: rhythm, dynamism, complexity and motivation.

COSMOCAIXA

- Reinforce the integrated vision of CosmoCaixa in terms of public perception, activities, and spaces (internal/external, virtual/physical).

- Support informal and enjoyable experiential activities (e.g. family labs), with the aim of actively involving people in creating and sharing scientific knowledge in a collaborative way.

CLUBHOUSE

- Establish mutually beneficial member/mentor relations by engaging people in collaborative and intergenerational artistic activities, and giving visibility to the artistic products (exhibitions).

SIGNPOST

- Create a network of people and places (schools, home, pubs, other public spaces) and design intergenerational activities aimed at constructing and sharing experiences and keeping their traces and memories in space and time.

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7. ANNEX

Annex I

Key dimensions for intergenerational learning in each case:

MAMAC:

- Social Dimension/Community/People (Intergenerational aspect)
- Space
- Learning Activity (qualities)
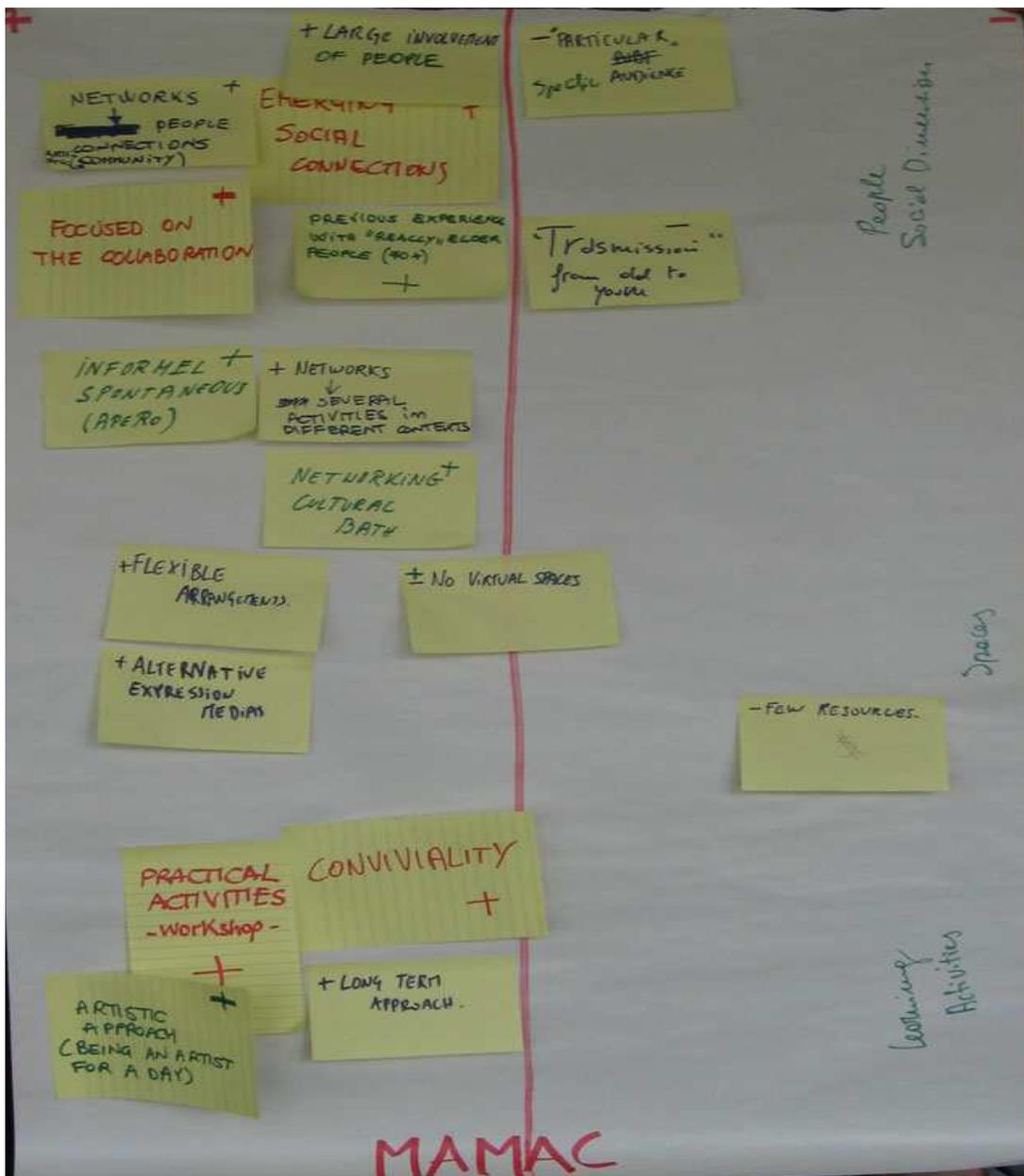
COSMOCAIXA:

- People and Roles
- Artistic Aspects
- Pedagogical Approach
- Space
- Media

CLUB HOUSE:

- Social Dimension/People (Intergenerational aspect)
- Time
- Space
- Pedagogical Approach
- Artistic Aspects

SIGNPOST:

- Social Dimension/People (Intergenerational aspect)
- Space
- Pedagogical Approach
- Media

ANNEX II: Case studies reports

1. Computer Club House in Viborg

By
Olga Timcenko

1. What is a Computer Clubhouse at all?

Main Computer Clubhouse idea is nicely described in introduction on their web-site [**¡Error! No se encuentra el origen de la referencia.**]:

"The world-wide Computer Clubhouse Network, established by MIT back in 1993, and supported by Intel, seeks to provide young people with the opportunity to work in a collaborative, supportive community to use technological tools to express and explore their own ideas and perspectives. The Computer Clubhouse model approaches technology development for traditionally underserved young people through the principles of design-based learning, a process that emphasizes creative exploration of materials and media to support the expression of young people's ideas and perspectives. In Computer Clubhouses, adults mentor and support young people pursuing their own interests while also encouraging a spirit of community-building. Focusing on the expressive and creative uses of technology distinguishes this model from traditional after school technology programs that emphasize either developing technical skills or reinforcing school learning through homework help and remediation."

The Computer Clubhouse Network is intended to respond to two goals of Intel's Innovation in Education initiative: to provide underserved youth with increased access to technology, and to encourage female and minority youth to enter technical careers. More specifically, the Computer Clubhouse Network seeks to provide young people with the opportunity to work in a collaborative, supportive community to use technological tools to express and explore their own ideas and perspectives. Intel is funding the creation of 100 Computer Clubhouses both in the U.S. and around the world.

More about Computer Clubhouse movement, together with relevant documents and research papers, could be found on the mentioned site [1].

Further on,]:
"In a successful Computer Clubhouse environment young people (ages 10-18) and adult mentors share expertise and support one another in using a range of technological tools (including 3-D imaging software, digital video recording and editing apparatus, and music recording and mixing equipment) to explore or express ideas and/or issues of interest to the young people involved. These qualities are summarized in the program goals, which are to improve young people's ability to:
• Express themselves with technology;
• Collaborate and work in teams;
• Solve complex problems;
• Develop, plan, and execute complex projects;
• Develop self-esteem and self-efficacy.
Essential to the Clubhouse model is the idea that young people develop a "technological fluency." That is, they learn to use a range of tools and media by creating original work, and come to understand how these tools can carry important messages about themselves and their worlds."

2. What is Computer Clubhouse Viborg?

Computer Clubhouse in Viborg, Denmark, (CC Viborg in the text to follow), is a member of international Computer Clubhouse network. It is a result of cooperation between Learning Lab Denmark (part of Danish University of Education, DPU, based in Copenhagen) and Viborg Commune. History and issues of establishing a Computer Clubhouse in Denmark are nicely described in [3].

Viborg is a town of app. 43.000 inhabitants located in central Jutland, Denmark. It is the seat of both Viborg municipality and Region Midtjylland, one of the five Regions in Denmark. The town is famous for its cathedral, dating back to 1130, and has played an important role in Danish history from middle ages. Nowdays it is a modern and well developed town. About 10.000 of its inhabitants are younger than 18 years, and app. 4,8% of them come from immigrant families.

CC Viborg is established with the mentioned general CC ideas in mind, but it also has some specifically Danish characteristics. It is not sponsored by Intel, but by local Commune. It is oriented towards all young people in the commune, not only socially underserved. It also provides environment and equipment for school-based week-long group projects. Mentors are from different backgrounds, varying from people with multimedia and programming skills, to those with pedagogical skills – so the model of working is more exchanging of experiences between youth and mentors, that classical mentoring.

Existing Computer Club Houses serve as exciting environments for researches, too. For example, in April 2004, IT-Center Viborg concluded a research project SAFT (*Safety,Awareness, Facts and Tools)* in cooperation with Viborg Computer Club House. The project was a research how young people use internet, and what the parents know about their children using the internet. The results of this project were disseminated on several conferences, but also on direct meetings with parents.

Work and experiences of CC Viborg will be object of research in this case study.

3. Formal organization and physical setting

CC Viborg is established by Viborg Commune. Viborg Commune provides for physical space, equipment (both hardware, software and books) and for salary of Computer Clubhouse leader. This means that all mentor's work should be volunteer.

Figure 1. CC Viborg leader, Kenneth Agernem

Figure 2. Entrance to CC Viborg and world-wide CC logo

Figure 3. Movie-making studio - camera and multiple screens for editing

There is a symbolic one-term charge of 100Dkk (app. 14 Euros) to become a member. This money has mainly pedagogical purpose – it is believed that it creates more serious sense of "membership" and belonging to the organization, for the beginning. Later, it is believed, members will found their interest, and continue coming because of that.

However, for those youth for whom this amount of money could be an obstacle to become a member (mainly young people from immigrant families), this charge has "unlimited due time", and it is never insisted that they should actually pay it.

Computer House leader is responsible for everything that happens in CC Viborg. He negotiates opening hours with members, so that it can suit their after-school free time. He purchases necessarily hardware and software equipment. As Commune's donations are barely enough for basic equipment, he is also searching for various sponsors. With sponsorship money, he was able to establish a music studio, fully equipped with expensive up-to-date technology. Also, whenever possible, members are encouraged to use free software, instead of expensive commercial products. This is different from a typical CC house sponsored by Intel, as Intel also provides licences for all needed software tools.

Physically, CC Viborg occupies 123m^2 divided into 6 rooms in an old army training center, converted in best Scandinavian tradition into new purpose, having a world-famous animated-movies school as the first neighbor. Atmosphere is friendly and cozy – newcomer can feel that "something is happening there". Just now, during April-May 2006, CC Viborg is moving in another building in the same complex – this time, they will get slightly more space, but in a single room with a elevated podium. This new settings brings both challenges and options - how to organize different noisy activities from previously separated rooms into one integrated area, so that benefits of being together are greater than inevitable disturbances.

CCViborg has 117 members (app. 30 of them coming during a day), 12 computers, music studio, movie studio, 1 permanently employed leader and variable number of volunteering mentors.

Figure 4. A typical day in CC Viborg

Figure 5. Musical studio and members working in it

Figure 6. School project week (not officially members of CCViborg)

Figure 7. Ethnic girls evening (not officially members of CCViborg)

Figure 8. Playing with robors - including LEGO robots

Figure 9. CC members ready to act in a movie

Figure 10. One day, for unknown reason, army decided to use its old area to lend a helicopter - which was a couse for lots of excitement and photographs among CC members

Figure 11. Planning high-tech project with low-tech pencil and paper - that is how lots of children like to start. Some are even producing beautiful pencil drawings, as inputs for digital modifications

Figure 12. No hard working day could be complete without drinks and sweets

4. Virtual space

Computer clubhouse Viborg has its own web-site, hosted by Viborg Commune. Screen shot of the main page is on

Figure 13. Members themselves have designed it using plain html.

Figure 13. CCViborg main web-page (http://www.computerclubhouse.dk/index.php)

As from

Figure 13 could be seen, the site is mostly text-based, with lots of relevant information in Danish. It is mostly used for messages of CC leader to members, and those messages occupy the central position on the main page. They mainly deal with adjustments of opening hours and some special events happening.

Anybody can visit the web-site as a guest, but members could use their own login and password to get access to a discussion forum. However, as it usually happens with web-site forums, it seems that it is not used – from 2003, there are just a couple of messages. One of them is a question: "Why nobody answers questions on this forum?". However, the forum is imagined as a meeting place to discuss general topics about CCViborg, specific topics about some hardware and software tools, and to recommend cool sites found on the web to other members. So, although the idea was good and potentially useful, it did not work.

Figure 14. Discussion forum web-page

On FAQ area, there are practical information about Computer Clubhouse Viborg, and about international computer clubhouse organization. Answers to typical questions are (translated from Danish):

"Computer Clubhouse Viborg is an offer available for all IT- interested youth, aged 12-22, in Viborg Commune.

Becoming a member: It is enough to come during opening hours for a short introduction given by the Computer Clubhouse leader or one of the volunteering mentors. They will show Computer Clubhouse space and equipment to a potential member, and they will present opportunities and samples of work that could be done in CC. Then a potential member will be given an application form. For potential members younger than 18 years, both member's and parent's signatures are required. For potential members older than 18, members signature only is enough. Then the application form needs to be delivered to Computer Clubhouse leader. An application fee of 100Dkk (app. 14€) needs to be paid together with the application. Although this amount is fairly symbolic, it is believed that it creates more serious commitment at the beginning of membership. Except for this one-term application fee, membership is completely free, and members could visit Computer Clubhouse during its opening hours as often as they wish. There are also examples when new members were accepted with an infinitely long deadline for payment of the application fee. This approach is used especially for members from unprivileged immigrant families who are not used to pay for free-time activities, and for whom payment of an application fee could become an obstacle for becoming a member.

Rules in the Computer Clubhouse:

Generally, there are not lots of rules – but there are some rules:

1. Members are required to treat others in the same way as they themselves would like to be treated;
2. Mobbing is not tolerated.
3. All the things should be kept in a reasonable order
4. Members should help peach other, so everybody becomes even better
5. Computer Clubhouse is a place where people come to learn something
6. If man cannot accept these rules, it's better that man finds another place to be!

Opening hours: Since its establishing, CC changed its opening hours several times – always in a dialogue with its members, in order to serve their needs better. Current opening hours are:

Monday 16.00 - 21.00
Tuesday 11.30 - 17.00
Wednesday 11.30 - 17.00
Thursday 11.30 - 17.00
Friday 11.30 - 16.00

During school vacations, opening hours change. In agreements with schools or other organizations considering special projects or services, other opening hours could also be arranged.

Grand opening was official CC Viborg opening – it was on 31/10 – 2003.

Contact:
Adresse: Rødevej 3, Hovedbygningen, 8800 Viborg

e-mail til ccv@viborgkommune.dk
Leader Kenneth Agernem, tlf (+45) 51584800

How to become a mentor:

One of ideas behind CC it is that members should get some formal and informal lectures and instructions by volunteering members. Mentors could have very different backgrounds, bur ideally they should have some computer-related knowledge. Students of pedagogic schools are also welcome as mentors."

Another interesting part of the site is a download area. Samples of member's work are free to download from here. This service is available for everybody. However, just minority of member's work is available here.

Each member has his/her own space on the site, with name, status, avatar, e-mail and eventual url address. This way, everybody could choose what to shoe to others from his work.

Figure 15. Members part of the site

There is also a common Computer Clubhouse network web-site for presenting and discussing work world-wide, Computer Clubhouse Village (http://village.computerclubhouse.org/clubhouse/login_form), protected by username and password – thus for CC members only, independently in a country and a club they are coming from. However, Village activities are not popular among CC Viborg members.

5. Types of activities – examples

List of software used by Computer Clubhouse Viborg:

Curious Labs Poser 4
Curious Labs Poser 4 PRO PACK
Macromedia Studio MX Windows
Macromedia Studio MX Mac
Macromedia Director MX Windows
Macromedia Director MX Mac
Macromedia Flash Communication Server
Corel KPT6 Pro Plugin for Windows
Scansoft - Super Goo
Mixman Technologies - Mixman StudioPro 4
Corel Bryce 5
Corel Pro Painter
Corel Graphics Work Suite 11
Adobe LiveMotion
Adobe Premiere 6
Adobe Acrobat 5
Adobe Indesign 1.5
Adobe Illustrator 9
Adobe AfterEffects 5

| Adobe GoLive 5 |
| Adobe Photoshop 6.0 |
| Adobe Pagemaker 6.5 |

Beside these programs they use:

Autodesk 3DStudioMax

Steinberg Cubase SX3

Propellerhead Reason 3

Digidesign Pro Tools

Adobe Premiere Pro 1.5
Adobe Audition 1.5
Adobe Encore

And several Open Source programs

All members are encouraged to use all the tools they need for their projects.

Typical CC activities include:

    a. Playing with creative software – editing photos, drawings, making 2D and 3D images

These are very popular among all members. Some samples of work are on Figure 16.

Figure 16. Samples of members Works

Figure 17. Prize for the best Photoshop image

Once in a while, competitions for the best image are organized in CC Viborg. The winner gets his/her name noticed in the "hall of fame" – a piece of wood with glued brush. Everybody loves this high-tech / low tech irony!

b. Developing web-sites

Making a personal web-site is also a popular activity. Although members are not allowed to work for money, there is an example of great cooperation with one of Viborg Commune's departments, when the CC member designed a web-site for them.

Figure 18. Web-site developed by a CC member

c. Developing computer games

One of CC houses mantras is that it is more fun to develop a computer game than to play one. There are examples of CC Viborg members making simple arcade games – a fully functional games that could be compared with their kind. A sample is on Figure 19.

Figure 19. Game developed by a CC Viborg member

Like in all games of this kind, an user has 3 lives, and by pressing arrow keys should control a ball to jump on different levels and collect maximum amount of diamonds – but he should be careful not to activate the dynamite or jump into fire.

d. Making music

Making music, both original and re-mixing existing stuff, is also very popular activity. Samples could be found on CC Viborg / download part of site. Members are also often making their own music to be used in animated and video movies.

e. Making videos

Members sometimes make videos that they both direct, act and create music. Typical length of these videos is several minutes, and they are either parodies, or carry some important attitude of their makers, typical for teenagers. Samples could be get in CC Viborg.

As CC Viborg physical setting is very special (old building, lots of corridors, large green area), it is usually used as background for movies. I've seen a musical movie, where 4 boys are singing a parody to a famous folk-song, and in the same time jumping and hiding in some land-works and holes in CC backyard. Another one was about suicide, where the tower of the famous Viborg Cathedral was used as Exterier.

f. Making animated movies

As this requires enormous amount of work, these are typically school projects. CC Viborg tries to cooperate with schools, and offers its equipment, space and leader's time to enable school children to work on their multimedia projects. Very popular are stop-motion animated movies, where characters are modeled out of clay. I've seen two of these projects, on topics "Mirrors" and "Being different". I was amazed with the high

quality – they had distinguishable style, characters were funny, there were unexpected humorous or ironical happenings, and at the end they have a non-trivial message…

g. Theme-evenings and theme-weeks

Usually once a month, CC Viborg organizes a theme-evening, and sometimes even a theme-week. The idea is that somebody very skillful in some aspect of technology, but without time to be regular mentor, gives a lecture and demonstration for interested CC members. Topics could be, for example, some aspects of using Flash to make animations, or shadows and lights in 3D StudioMax. This increases the learning curve of participants, and empowers them to better use their tools.

Another happenings are theme-weeks, when participants work on some issue for a longer time. These could be already mentioned animated movies, or building and programming LEGO Mindstorms robots.

h. Integration example

Original CC idea is to serve youth from under-privileged environments. However, majority of children coming to CC Viborg are ordinary middle-class children – and many of them also have computers at home. CC Viborg is always trying to recruit more members – and traditionally under-privileged children in Denmark come from immigrant families.

There is a positive example of CC Viborg's beneficial influence on life in Viborg Commune. That is its cooperation with Commune's department for youth. A group of young people (15-20 years old) of immigrant origin was formed in the town. They left school, were without jobs, and spent their days gathering on specific streets and squares, bothering others. Commune offered them a club-room where they could meet, in order to move them from streets, but that was not enough. They needed some meaningful activity to be engaged with. The leader from Commune's youth department contacted the leader of CC House Viborg, and they agreed to try to engage these young people into CC Viborg activities. However, they could not expect these young people to pay for membership themselves. It is not reasonable to expect that second-generation immigrants, coming from families with no customs to pay for free-time activities, will be willing to spend this amount of money. Thus, they haven't been charged the fee. The experiment, which is on-going, shows to be successful – some of the members from this once trouble-making group started to visit CC House regularly and to be engaged into its activities.

This is very much in line with original American CC-idea, where CC Houses are primarily meant to serve under-privileged youth – and in Denmark, we can say that some of second generation immigrants belong to under-privileged groups.

Another example is organizing a theme-evening only for girls from immigrant origin. Lots of girls come to initial meeting (as can be seen on Figure 7), and even some became members.

2. Issues for future exploring

After all mentioned activities in physical and virtual space, a reader could get an impression that CC Viborg is an ideal place. However, the leader Kenneth Agernem is constantly struggling with basically two things:

1. How to attract new members and keep old in competition with all sports, after-school work and other activities Danish children are typically involved;

2. How to recruit enough skillful mentors. In Denmark it is not usual for persons with high-tech skills to get engaged into volunteer work – they usually require (and get) high salary.

For now, majority of theme-evening presenters are Kenneth's personal friends, or friends of friends. It works pretty acceptable, but could be improved.

If these first two issues are somehow improved, there is the third one, maybe the most interesting – how to engage, motivate and encourage members to be involved in longer-term and more complex project – because real learning and creativity typically happen there.

Kenneth is very open for any form of cooperation and suggestions. He already had requests to use CC Viborg as a learning place for elderly population (using e-mail, browsing the web), but had to refuse, as that is not in core CC idea. But he is open for possible modifications of settings, so that CC Viborg could become a really multigenerational learning and creativity place.

From La Piazza perspective, researching relation between members and mentors is a crucial issue, as multigenerational learning happens here. If we succeed to figure out some learning/creative benefits for mentors, maybe the problem of recruiting mentors could become at least a little smaller.

1 Literature

1. Computer Clubhouse Web page, http://www.computerclubhouse.org/

2. T. Pryor, K. McMillan Culp, M. Lavine, Jessica Hochman, "Evaluation of the Intel Computer Clubhouse Year Two Report", published: September 2002

3. Lisbeth Frølunde, "Evaluation of the Computer Clubhouse Denmark project", February 2004, Learning Lab Denmark

2. MUSEUM OF MODER AND CONTEMPORANY ART (MAMAC)

By
Françoise Decortis
Stéphane Safin

1 Context

Our case studies are focused on intergenerational cultural/artistic activities, in collaboration with the MAMAC (museum of modern art and contemporary art) in Liège, The MAMAC, is the biggest museum in Liège. Situated in the former « palais des beaux-arts », a building of the world expo of 1905 in a remarkable park in the hearth of the city of Liège.

MAMAC Building

The museum is divided in two areas, changing over time. The first is dedicated to the exhibition of the permanent collections of paintings and sculptures – from 1850 to nowdays. The second part is dedicated to temporary thematic exhibitions. These exhibitions last from one month to three months. The themes are varying. For exemple, the last exhibitions were about the Brazil, …

These two areas are installed in the whole space of the museum. The arrangement of these spaces change frequently.

Inside the museum

Another museum, the "cabinet des estampes et dessins" (museum of engraving and drawings) is also present in a room in the basement of the building.

The MAMAC is also a central point for the network of a part of cultural life in the region. Many non profit associations, working in different areas of artistic and clutural projects, are in some ways linked to the museum. The museum is a kind of window for many projects, offering a prestigious large space of exhibitions.

This part of the deliverable synthesizes two cases studies that took place in Liège (Belgium). These case are cultural and artistic intergenerational activities. For these descriptions, we've met two persons :

- Case 1 : **Michel Antaki** is the organiser of the exhibition « Digestions: Memory and Transmission », the founder director of the "Cirque Divers", an important cultural place in 70-80 years. He's currently the director of the non-profit association "d'une certaine gaité" organisation of permanent education in cultural domain.

- Case 2 : **Werner Moron** is an artist, specialized in intergenerational cultural activities, in cultural workshop for youth, especially in the framework of the "youth houses federation"

The data consists of interviews with these two people. This document is a synthesis of the results of the studies.

2 Description of the case studies

2.1 Case 1 : Exhibition "Digestions : memory and transmission

It was an exhibition in MAMAC (Museum of modern art and contemporary art in Liège) from September to October 2005. The goal was to create a link between youngsters and elders with many events, and a work on the archives of the « cirque divers »,

The goals were :
- A (re)insertion of the elder in the society. « *If the elder have made something and they think they have to transmit it, that helps them to live* »
- « *There is a fundamental need of redefinition of generational roles, vital for our societies … All this participate to a problem of identity, generalized in current times* »
- It's primarily a issue of transmission, that is from elder to youngsters

The activity consisted in :
- At first, the creation of a convivial space for the discovery of the archives of the "cirque divers" and the meeting between youth and elders : "apero-archives" In these moments, collaborations have been built with 3 schools, that have inserted a work on these archives in the curriculum of the classes.
- Then the main activity was a work of inspiration of the students on these archives for the creation of art works. These two first activities lasted about one year
- Then, for the final activity, the art works have been exhibited in the museum.

During the exhibition, many other events took place in the museum. The most significant are:

- Invitation of young artists « heirs » chosen by the older artists who had participated to the "cirque divers" activities.

- Conferences specifically dedicated to the intergenerational issue: feminism today, social movements post-68…

The pictures show some of the art works created for this exhibition

2.2 Case 2 : Intergenerational artistic workshops

Werner Moron made several intergenerational activities:

- Implication of youth for the exhibition « biennium of photography » (March-Aril 2006 in Liège)
- Intergenerational animation activities for the promotion of a cultural centre in Belgium
- Artistic animations in schools and other organizations

For him, intergenerationality is « *a decision of artist. Something strong* ». He has willingly left his functions in several institutions in order to work on the issue of the transmission.

The case we develop here is the intergenerational animation for the promotion of a cultural centre in Belgium. The goal is to attract neighbours in contemporary arts exhibitions in a cultural centre thanks to a work with younger and older audiences.
The target groups are youth (10 years old) and elders (70+)

About the organization of this activity, there is a work in three times.
- The first with separate groups. For the youth, the idea is to understand how they situate themselves in their city. For the elders, he tries to know what they wish to say to youngsters and how they would have, themselves younger, answered to the questions asked to the youth.
- The second time will take place together. This meeting will occur soon. It will be organized in a concrete way : something to share, prepared questions, a microphone to have something formal,…
- Then an art work will be prepared by each participant, and will be exhibited.

3 Digestions: Evaluation

This activity being terminated, it was possible to make the following conclusions :
- The youth seems to have invested happily in the activity.
- For the elder, seeing their art works "digested" by the youth has brought them something. The real dialogue took place in the artistic creation.
- This event has created « *a new way to do* ». Many contacts have been generated between generations. Connexions have also been created between art schools and cultural actors
- This experience is qualified as a *laboratory*. Not many visitors, but it's a first work. The idea is now to exploit the traces of all the activities.

4 Dimensions

Werner Moron and Michel Antaki have highlighted several factors in intergenerational activities, that can be tools, facilitators, reflections about the goals or methods,… We classified these factors in four dimensions: Time and space, Person and Identity, Reciprocity, and Media

4.1 Time and Space

DESIGN OF A SPACE

Aperitif-archives. Convivial space for encounters, discoveries, questionings. It's an informal setting, broad-minded in a dedicated space (agora) focusing on conviviality and freedom of exploration.

REFLECTIONS ABOUT TIME

If one wants to do an intergenerational work, one needs to appropriate oneself a different time, to agree to reflect on the issue of time.
There are individual times that are different between generations.
One need to design collective time, to create rhythms. One need intra and intergenerational moments. If people are put together too quickly, one can loose something in the richness of tee meeting.
Intergenerational activities are not simple in terms of speed of result. It is inversely proportional to the demands of the current era. «*These projects must have a disproportionate ambition in time, history, and at the same time a very great humility in terms of result. It is necessary to find money to give oneself time, to find fundings without having to justify this time* »

4.2 Person - Identity

NETWORKS

To initiate intergenerational activities, it is necessary to use pre-existing networks. To attract youth, they have to be guided by an existing structure. « *In every transmission, the path has to be indicated* » The encounters can create new networks, facilitating intergenerational meetings.

PLACE OF PEOPLE IN THE SOCIETY

Intergenerational work, and transmission, is a mean for elders to have a role in the society, to define themselves a new identity.

"TRAJET RÉEL - TRAJET RÊVÉ" : REAL JOURNEY - DREAMED JOURNEY

The idea is to do a work with the young people on "trajet réel - trajet rêvé" « *once that one made the observation of a trivial reality* (trajet réel), *one can convene his imaginary* (trajet rêvé) » « *They have to know from where they start to express themselves, and be conscious of that* ». Often the youth "borrow their identity" «*They regurgitate, in the framework of the expression, MTV pre-formatted discourses* ». It is a responsibility to understand who the young is really.
The subjacent reflections come from experiments with young people in an art school. « *Before working the expression, it was a question of seeing who they were, in what they were anchored. See why they did not express their own day-to-day, but were constantly out of them, in the reference* »

4.3 Media

ART AND INTERGENERATIONAL LEARNING

The transmission to youth has never been a central issue in the plastic arts (vs theatre or music). There are elder and youth, but the issue of filiations and continuity has never been asked. It starts to emerge now.

Art is pedagogically interesting for working with youth. « *The boss is not us [But a product, a deadline…]. It is not friendly or evil* ». The requirements are precise, clean, unambiguous. One can be quite rude because the requirements are hard. « *When in music one asks for a* la*, it's a* la*. In other types of activities one can not have this kind of requirements. That allows a relationship that is not politically correct* »
The introduction of the notion of audience is another kind of requirement that allows deep reflections.

"CULTURAL BATH"

In the artistic activities, the idea is to create "cultural baths". It mean places of meeting allowing the expression not by the discourse but by artistic means. « *If one gives us the means of being in a cultural bath where people are at the same time experimenters and experienced, where the things are thought by other thing that [the speech], but by the perfume, the colour, ... People would understand each other without knowing what they have said* »
There are no objectives in terms of "results" (that they paint well, that they make beautiful music...) they will be natural consequences of a work well done on the level of a cultural bath. Thus one of the objectives is the cultural baths, where « *adults who have the information, meet youth who did not even know they need those* »

4.4   Reciprocity of learning

Michel Antaki talks of "transmission", that is a unilateral dialogue. The youth is there to learn, and the elder to transmit. The feedback occurred through the artistic creations.
For him, youth are mainly resources for the learning of techniques. « *By teaching me the technique, I learn it on my way, he sees how I learn it, and at one moment there is a exchange, a share. That makes me ask questions about the technique, about his life, and I reflect about myself* »

Werner Moron : « *I talk about transmission because it's like that that I can understand intergenerationality* ». There's a one way dialogue. Transmission in the arts it's to give a way to work, to learn ropes that are not taught in school.
Youth are resources mainly for pragmatic (technological) problems « *They have natural ease to make some things* » (graphics, communication).
Nevertheless, « *In fact I'm also fed by them* […] *They have access to new networks, they apprehend the current world. I feed myself with that* »

5 Further collaboration

For the continuation of the case studies, and/or for the design sessions, many activities can take place in the framework of our collaboration with Michel Antaki, Werner Moron and the MAMAC :
- Special edition of the C4, cultural magazine.
- Exploitation of the "digestions" traces.
- "Quand les jeunes s'en mêlent" conference and radio show on the elder, seen by the youth (1 april - 6 may).
- Design and evaluation of intergenerational activities in the framework of "biennale de design" in MAMAC (september)
- Observation of intergenerational artistic activities of Werner Moron

3. **COSMOCAIXA**

By
Mario Barajas
Aina Chabert

1. Introduction

CosmoCaixa is a centre for popularizing science. Its participative and educational methodology is based on interactive experimentation; from a series of exhibition models that the visitor can manipulate and follow according to guidelines, scientific principles can be concluded.

The exhibitions, many of them travelling to different places in Spain, courses, meetings, film showings, and teaching performances are some of the activities that make the museum a dynamic and lively social centre of scientific knowledge.

2. Methodology of the case study

This report is the result of four official visits to *CosmoCaixa*, the science museum of Barcelona.

Visit	*Task carried out*	*Stakeholders*
First	Albert Einstein Exhibition: Visit the exhibition as external observers of a participant group. **Interview with:** • Monitor of the Exhibition Albert Einstein • Education area Director First "La Piazza" report: • Description of the museum's physical spaces • ICT in the exhibition space • First ideas about intergenerational learning	Monitor of the Exhibition Education area Director

Second	The iguanodon Exhibition: Visit the exhibition as external observers of a participant group Participation as external observers in the exhibition workshop **Interview with:** - Monitor of the Exhibition The Iguanodon - Monitor of the Workshop	Monitor of the Exhibition Monitor of the Workshop
	Re-elaboration of the first report considering the new inputs	
Third	General visit to all the museum spaces Active participation in the Family Activities Presentation of the virtual spaces **Interview with:** - Monitor of the family activities - Second interview with the Educative Area Director - One family participant	Monitor of the family activities Educative Area Director One Family Participant
	Incorporation of the virtual vision into the report	
Fourth	Visit to the special session of Planetarium for young people	Planetarium expert

Parallel to the interviews specified in the top square, Professor Nuria Serrat, doctor of specialized pedagogy in museums and education, collaborated in the orientation of this process. Her support has been invaluable in providing theoretical orientation and bibliographic recommendations.

3. Context

The Museum of Science of the Foundation "la Caixa", first opened to the public in 1980, was transformed in 2004 into a new entity, *CosmoCaixa*. The opportunity to begin anew is a rare privilege for a museum. There are many reasons for this transformation, but perhaps the most important is the possibility to put into practice what had been learned during two decades. *CosmoCaixa* follows a new concept in museums intended to meet the challenges of twenty-first century society. This project has employed new techniques, methods, and museum standards that have been created and debated in recent years in international forums and tried in temporary and traveling exhibitions.

The new building of 50,000 square metres is eight times larger than the old museum and was conceived with the objective of "changing the lives of the visitors." This new construction is a project of architects Esteve and Robert Terradas and has been designed in accordance with its contents, while respecting the environment and conserving the nineteenth century modernist building that was the headquarters of the old Museum of Science and now houses the offices and workshop areas.

4. Objective of *CosmoCaixa*

CosmoCaixa forms part of one of the lines of development of the La Caixa Foundation: Science and Environment. According to Esther Arderiu, one of the responsible people in the Area of Education and Programming, the key objective of the interactive museum is:

> *To popularize scientific knowledge for people of all ages, to evoke sensitivity and feeling in the visitor who wants to learn.*

5. Users

This interest in popularizing science is manifest throughout the centre. The museum is open to everyone. We can find proof of this in the inexpensive offerings of the institution as well as the great variety of activities designed from different pedagogical perspectives to attract the greatest possible number of people with different intellectual levels.

The general admission ticket to *CosmoCaixa* costs three euros. There is a reduced ticket for students and retired people of two euros, besides scholarships for schools to allow them free entrance. Also, the first Sunday of each month and on certain holidays the museum opens its doors free of charge.

The diversity of programmed activities covers a wide range of ages, cultural levels, and personal interests. So, in the same space, we can find many possibilities for self-

directed journeys through the museum as well as guided tours for families, schools, private groups, etc.

These initiatives, together with the great amount of publicity about the museum and the history that surrounds the centre, insure that the visitor profile is as full, rich, and varied as the population of Barcelona. It is a fact that it is one of the best known and most visited museums of the city.

6. Physical Space and Activities

Physically, the museum occupies a space of 50,000 square metres covering five floors. This space is divided into two types:

- o Permanent spaces
- o Travelling Exhibitions

6.1. Permanent spaces

In the permanent spaces there are nine different sections organized according to theme, age, and scientific objectives.

6.1.1. The Rainforest

In this space there is an exact reproduction of a part of a rainforest in the Brazilian Amazon—it covers more than 1,000 square metres. One can explore not only the rain forest but its relation to the earth. There is also a subterranean view, an aerial view, and the tropical rain—all complete with the typical flora and fauna of the zone.

The team of the new Museum of Science went to Para, en Brazil, to take casts for faithful reproductions of the huge trees, such as the *ceibas*. In addition, they have incorporated more than 100 live indigenous plant and animal species. The rainforest brings to us one of the ecosystems richest in biodiversity, as well as most fragile, in the world.

6.1.2. The Geological Wall

The geological wall is one of the emblematic elements of *CosmoCaixa* Barcelona. Each one of the panels illustrates a geological structure accompanied by an experiment especially designed by the museum's technical experts that shows the geological processes.

6.1.3. The Room of Matter

This is a permanent exhibition where experiments, authentic objects, and living beings take one on a journey through the evolution of matter.

Since the beginning of the universe, 13,700 million years ago, there have been four great milestones: the first, the origin of matter; the second, the appearance of the first living organism; the third, the appearance of symbolic intelligence; and fourth, the

emergence of civilization. This has been the guiding criterion for organizing this space. Avoiding the general scientific categories of matter, this space wants to suggest a scientifically determined vision.

Perhaps this is the space that is most characteristic of the museum's methodology. Each scientific message is constructed with objects, images, and presentations using a large variety of technological resources.

One of the museum monitors who has a degree in physics and is in charge of some of the travelling exhibitions was interviewed. In his opinion:

> *This new plan of the Museum of Science, or rather, this part of it, seems to me better than the previous one. Even so, I consider one step more needed in the conception of these spaces, above all, in the number of exhibitions. In general, when an exhibition is organized, it is always necessary to explain everything, to guarantee that the visitor receives adequate information in the best way possible. (…) In my opinion, there isn't enough space for inductive discovery. CosmoCaixa is working on this point, but it is still a problem. If you look throughout the space you can find many experiments that allow the visitor to get involved and find the scientific method, but all these experiments are accompanied by signs with explanations that the visitor can read previous to getting involved. This means that more than "discovering" the principles of science, what the visitor is doing is "confirming" them. (…)*

6.1.4. The Planetarium

The Planetarium offers a great visual experience to people of all ages, a total immersion in realistic astronomical spheres where one can observe the universe from different perspectives in different time periods thanks to an advanced system of 3D astronomical simulation and a powerful high definition audiovisual system.

Within this space there are two types of presentations that change according to the weekly schedule. The current ones are:

a) **Genesis:** a classic presentation of the creation of the universe aimed at the general public.

b) **Cosmic catastrophes:** a story based on the "Manga" aesthetic in which one sees the most important stages of life in the known universe, an audiovisual oriented specifically to young people between twelve and twenty.

This space also offers a family activity. There is a film especially for children in which the basic contents are presented as a story.

6.1.5. The Bubble Planetarium

The Bubble Planetarium is a space created especially to awaken the curiosity of the youngest visitors about the world of astronomy. It is a little cosmos where they can discover the sky, the planets, and the history of the constellations. Its purpose is to help

children learn how to look at everything in the night sky and to begin to identify what they have seen in the museum.

6.1.6. Science Square

CosmoCaixa has opened a new public square for the city of Barcelona, a large esplanade of over 5,000 square metres for enjoying the environment and science. In the near future interactive models will be installed—sculptures, machines, and experimental structures for discovering and understanding the elements of nature scientifically.

This space is totally free during museum hours. The activities developed there are open to everyone and, through them, the goal is to strengthen relationships between citizens and to sensitize everyone to science in a totally playful atmosphere. Some of the activities have been: animated scientific shows, trips in hot air balloons, open-air cinema, and giant chess days for children.

6.1.7. Click and Flash

The Click, for boys and girls from three to six, is an interactive space where play, observation, and deduction become tools of discovery. Through smells, touch, bubbles, and machines, the space aims to awaken the curiosity of the youngest visitors about the world of science and to stimulate an experimental attitude. Accompanied by adults in school or family groups, children will have their first experiences with science. What can happen in this space is to "click on" the child's inner desire to discover the world.

6.1.8. Touch! Touch!

This space presents a unique way of knowing the environment, nature, and animals. The goal is to encourage respect for living beings through a better understanding of their habitats. There is a set of activities for everyone based on a direct contact with three emblematic natural spaces on the earth: the rainforests, the Mediterranean, and the deserts.

There are many experiences guided by specialists that, from a scientific point of view, allow surprising observations of the world around us.

6.1.9. The Red Line

Through two specific examples of forest exploitation, one in the Amazon jungle in Brazil and another in the Montseny (Mediterranean woodland), this space is intended to show how scientific knowledge can establish the fragile boundary between lasting wealth and sudden ruin. The Red Line is the boundary beyond which a forest cannot be exploited without affecting its conservation.

6.2. Travelling Exhibitions

The museum dedicates space to temporary exhibitions. All of them follow the same pedagogic principles of empirical experimentation held by the museum.

The three most recent exhibitions, located in three different spaces, have been:

a) Einstein, 1905, one hundred years of physics
b) Jules Verne, travel, travel, travel
c) The Iguanodon

6.2.1. Einstein, 1905, one hundred years of physics

In 1905 Albert Einstein published five articles that revolutionized twentieth century physics. To commemorate this, *CosmoCaixa* organised an exhibition. Einstein's contributions to science radically changed the way people understand the universe and created a revolution in the understanding of light, space, time, matter, and motion.

The exhibition, Einstein, 1905, one hundred years of physics, was designed to allow visitors to experience the excitement of these fundamental discoveries. The challenge was to transmit concepts that are not intuitive through real objects, experiments, and audiovisual resources. The exhibition demonstrated what lies behind his contributions as well as the practical applications they have led to, such as GPS, nuclear energy, and MRI.

6.2.2. Jules Verne, travel, travel, travel

The legend of Jules Verne (Nantes, 1823 – Amiens, 1905) forms part of the collective imagination of millions of people. His novels take place in a mythic territory in which adventure, discovery, and passion for knowledge are combined. His point of departure is always the journey: to travel for discovery, to travel to make change, and to travel for dreaming.

The exhibition centres on the interesting relation between Verne and science. He was up to date on the latest scientific discoveries and advances, and was able to make realistic extrapolations from the inventions of his time. He was a pioneer in the popularization of science.

The exhibition was divided into two parts: the Verne Space and the Verne Route. Following the Verne Route visitors took a journey by museum models that showed the natural phenomena that Verne cites in his novels. In the Verne Space there is the personal atlas of Verne, a giant squid, a diving suit from the beginning of the last century, and a moon rock. These things introduced visitors to the life and work of Verne and taught the basic aspects of his work.

6.2.3. The Iguanodons

As a result of collaboration with the Belgian Royal Institute of Natural Science, for the first time, six iguanodons left their usual home to come to *CosmoCaixa*. This is a group of herbivorous dinosaurs from the Early Cretaceous found in 1878 in Bernissart, Belgium. Six specimens up to six metres long were in this unprecedented exhibition that shows, through the explanation of the changing hypotheses that were made over

time with these specimens, that scientific knowledge is falsifiable and subject to continuous review.

7. Virtual Spaces linked to the Physical Spaces

CosmoCaixa is technologically oriented by definition. All exhibitions, activities, and spaces follow the scientific method and direct experimentation. In many cases the experimentation must be virtualised through the use of technology, such as video, radio, digital systems, and computer programs. Even so, regarding new technologies, *CosmoCaixa* isn't as developed as it could be.

The website of the museum (www.*cosmocaixa*.com) offers a virtual space, "Virtual Experiments", in which one can follow some of the activities of the centre.

On this website eight different activities are presented in a way the user can interact through virtual characters, stories, and simple games with some basic scientific concepts.

Azonamia. The rainforest offers a virtual presentation of a part of the physical space that allows some interaction with select elements through a sequence of simple actions, allowing the user to obtain relevant information about the Amazon jungle.

Genobi. The space of the Inert Matter (one of the areas of the Room of Matter) has a simulation game in which, assuming the role of detective, the user must find a meteorite lost in space.

Panage. This virtual activity belongs to the physical space The Geological Wall. Here the user discovers the different realities that exist below the surface of the earth by driving an excavation vehicle.

The space related to Live Matter (the Room of Matter) presents two activities:

Mahgori. The user becomes an ant more than twenty million years old. It must survive the great catastrophes that lie ahead while the user discovers basic information during the journey.

Post-Oderté. The scientist who was preparing the exhibition about the Devonic age, pass out. Through a strategy game, the user must collect all the information needed for the exhibition.

Civilized Matter has two more activities:

Lafa-Tebos. To succeed in getting out of the cavern, the player must decipher messages in ancient writing.

Nahumo. Here the user becomes a cave painting of a prehistoric youth, who, through the tests that his father gives him, must learn to defend himself, to hunt, and to know his culture.

Finally, the space of the Planetarium has a virtual space with the game **Slo**, in which a space ship looks for intelligent life in the universe.

As we can see from this description, the basic structure of these activities is very similar. It is a dynamic mode of learning and select information that, though limited, allows the participation of the user.

According to the interview with one of the education area directors:

> *There is a certain disengagement between the physical spaces of the museum and the website. Presently, the educational offering on our website is very limited and, for the moment, there is no immediate plans to work on the problem.*

Virtual

Azonamia

Slo

Mahgori

Panage

Lafa-Tebos

Post-Oderté

Genobi

Nahumo

Inert Matter

Live Matter

Civilizad Matter

Room of Matter

Rainforest

Geological Wall

Planetarium
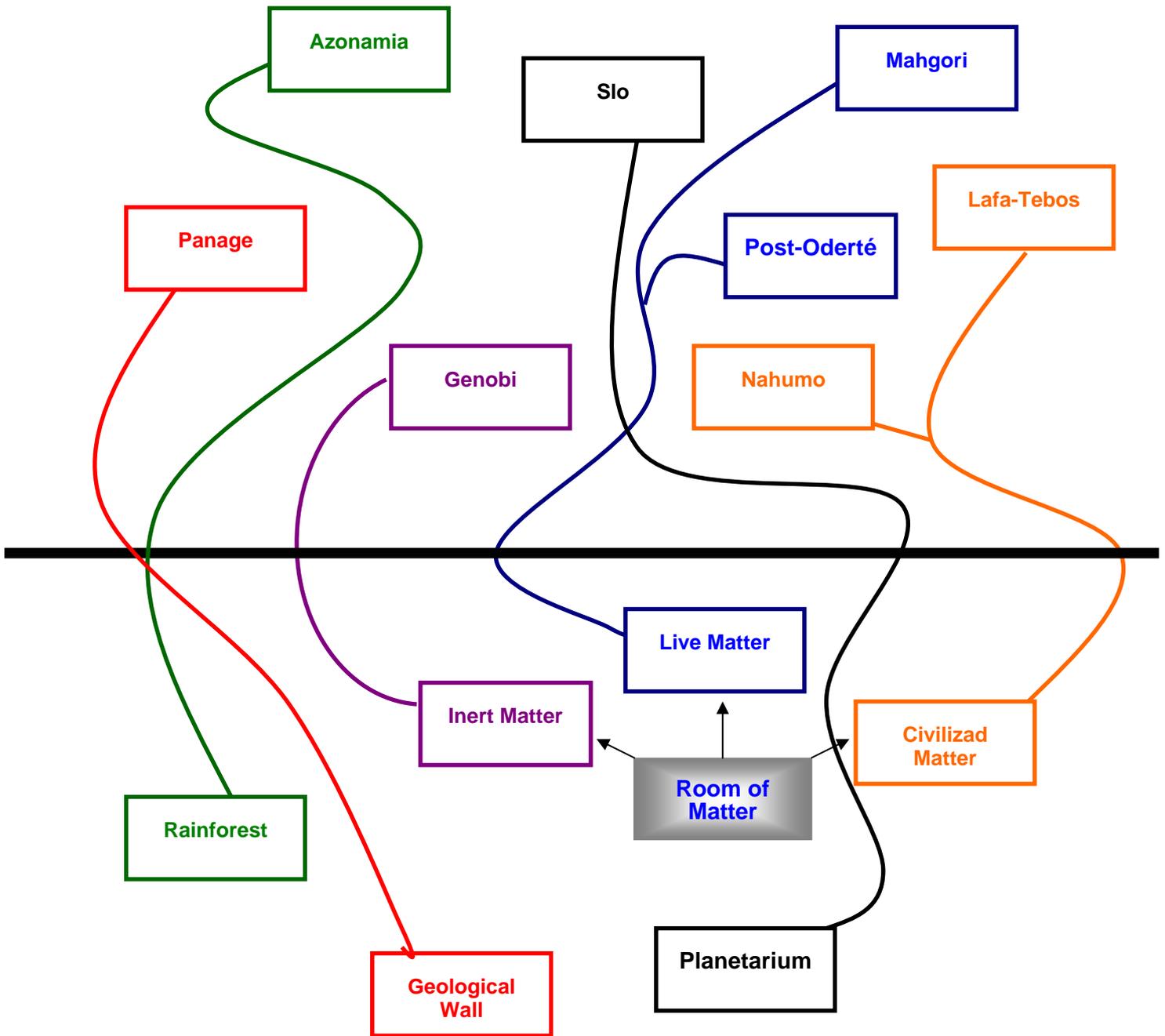
Physical

8. Intergenerational Perspective

The pedagogic concept of *CosmoCaixa* is based on working with the largest, most varied public possible. For this, the museum gives visitors the opportunity for different complementary activities in order to optimize the fulfilling of the centre's objectives to popularize, sensitize, and raise awareness on science.

Within this educational approach we find the following activities for the visitors:

- o **Family Activities**
- o **Laboratories**
    - o General Public
    - o Schools
- o **Guided Visits**
- o **Conferences**
- o **Talks**

In this sense, the intergenerational opportunities to learn lie in the family activities and on the laboratories.

According to the education area director:

> *In CosmoCaixa we try to disseminate scientific knowledge to the largest possible segment of the public, and though one can find an intergenerational aspect implicit in the activities, there isn't any work being done specifically on this. In this sense, we are very interested in the contributions that La Piazza can offer us.*

8.1. Family Activities

The activities oriented to families are workshops that take place at different times during the weekend. In them they work in an active and experimental manner with some of the concepts that they find in the museum. The level of these workshops is usually basic in order to include the youngest members of the family. The activities that are carried out are planned to be participated in by all members of the family, with the oldest becoming facilitators in the teaching-learning process.

According to the monitor of family activities,

> *It is very interesting to see how the participation of the parents in the workshops evokes the interest of the children and vice versa. Many parents want to participate in the activities to be an example for their children, though I believe in the majority of cases it's the children who are being the example for them....*

After interviewing one of the participating families we made a significant observation: the participation of family members of different ages creates a playful atmosphere which favours a better learning and a more efficient use of the activities, the resources, and the spaces. An example that illustrates this very well is **Camil**, a twelve year old girl, who said:

I laughed a lot when Ariadna's hair stood up from the static electricity. It was fun, but I was scared when my mama screamed from the discharge of the condenser…. She said that it didn't hurt, but the "Miss" (the monitor) said that we have to be careful with it. She said there is good and fun electricity and dangerous electricity…but it was fun….

She was able to manage correctly the working concepts of the workshop thanks to her connection to people close to her holding different roles.

8.2. Laboratories

There are two types of laboratories: those aimed at the general public and those specifically for schools. In the first, the methodology is similar to the family activities, but in these the user profile is completely heterogeneous and the activities carried out offer a conceptual level a little higher. The school workshops are held from Monday to Friday and are generally offered to school groups of a determined educational level.

According to the monitor of the school workshops:

The same workshop can be given for students of various ages. It is enough to increase the difficulty of the contents. Even so, the methodology used by the groups is always the same. It would be interesting to vary the methodology according to the group, but this would cost a lot.

9. Conclusions and Key Findings

We can consider that the activities CosmoCaixa carries out hold a certain intergenerational learning component which include the use of ICT for providing a better learning space. However, it seems that this component is a by-product in the general objectives of the museum, and not part of a specific plan.

It is for this reason that we cannot find a strong working link between the intergenerational approach and ICT. Proof of this is the new space "Science Square". This space, which has been conceived to promote informal educational interactions among a heterogeneous public, is not offering right now continuous activities; its activities are developed intermittently during some special days, holidays, and celebrations, but at least until now, they almost never include virtual elements nor intergenerational learning events.

However, we can state that *CosmoCaixa* presents a wide range of intergenerational opportunities mediated by ICT, that haven't been exploited to a full extent. It is not a matter of investing in new spaces or ICT equipment, but of optimizing and linking each focus. We then consider that it would be interesting to intensify the virtual dimensions of the exhibitions, such as creating a real-time online visiting space in which activities with different objectives can be embedded. It would be also good to offer the user the possibility to continue his or her visit from home, so that giving opportunities for

intergenerational family-based visits; from an educational point of view, this could be the link between the informal educational spaces and the classroom.

One of the strong points of this interactive museum is the fine adaptation of spaces to the child's reality. Presently, there is a full programme of both exhibitions and activities for all the public, so it won't be difficult to promote intergenerationality. In one way or another, this continues being a neglected area. Our purpose here continues being pedagogical.

Our suggestion for improving the intergenerational learning dimension of *CosmoCaixa* is to create a concrete methodology that will link all the existing ICT resources with the existing physical spaces, either re-conceptualising the exhibition approach, taking into account the intergenerational aspects, the virtual dimension and the physical spaces. One opportunity for the near future would be to redesign the "Science Square", a perfect example of embodying La Piazza concept into a reality.

4. **SPACE SIGNPOST**

By
Keri Facer with some additions by Martin Owen

The Space Signpost project is an attempt to develop a new approach to public understanding of science that empowers individuals to explore questions and ideas of interest to them in the solar system. The prototype is an experiment intended to discover what sorts of representational systems can encourage users to confidently explore questions of science and discover answers for themselves.

The installation itself consists of a moving signpost linked to a digital touchscreen. The signpost moves to point to an object within the solar system of the user's choice and displays the changing distance to that object on an LED screen on the sign. The digital touchscreen provides further information about this object, and offers users a range of different options for interacting with three-dimensional representations of objects within the solar system. The installation is designed to be located in an outdoors public space likely to be affiliated with a public institution (for example outside science centres or galleries) and to be usable by the full range of the public, with appropriate accessibility for individuals with physical disabilities. The installation can be described as a cross between street theatre, street furniture, installation art and science centre exhibit.

The over-arching aims of the project were:

- to empower users to conceive of astronomy not as a domain both literally and conceptually 'out there' (either in 'outer space' or in the scientific arena) but as a domain within which we live and breathe

- to facilitate confident engagement with scientific representations that can be interrogated by individuals in the ways they interrogate and interpret the signs and symbol systems of their local neighbourhood.

The Space Signpost (formally Welcome to the Neighbourhood) project consisted of two phases of development:

The technical development of the project was conducted in-house at Futurelab between Adam Nieman, the designer and concept artist and Alex Burton the programmer, a process that enabled close cross fertilisation of ideas between programmer, content developer and research and technical teams at Futurelab. It uses open source software, Celestia, and has involved the development of a flexible HTML interface to allow modular changes in further development.

1 FIRST PHASE PROTOTYPE DEVELOPMENT

1.1 Research and development questions Within the two over-arching research aims outlined above, the project development has focused on the following specific questions:

1. What are the key questions that a wider public audience is most interested in exploring about the solar system?
3. What representations will most easily enable users to answer and explore these questions?

4. Does the presence of a concrete external reference frame aid navigation through and understanding of the digital representation of space?
5. Does reference to actual objects and real distances help users make a link between a 'god-like' three-dimensional representation on the screen and an actual view of the sky?
6. What type of interface is likely to encourage confidence in users to explore and interact with a digital resource?
7. Which facts or ideas or tools stimulate enquiry or provoke questions?
8. How do pre-existing conceptions of space conflict with the language or mode of explanation in SPACE SIGNPOST?

There are also three further generic research questions that each Futurelab prototype needs to address:

1. 1. What does this prototype tell us about the best ways of designing digital resources for learning?
2. 2. What does this prototype tell us about how informal learning processes can be transformed through use of these tools?
3. 3. How does this prototype help us understand the potential of next generation technologies to create intrinsically motivating and engaging learning experiences?

1.2 Prototype development

1.2.1 First phase concepts

The first stage of any project is the development of its overarching aims and objectives as outlined above. In the early development stages, Futurelab staff and Adam Nieman worked to develop an appropriate 'metaphor' for the project. From the many initial ideas Adam brought to the table (including science centre star installations to outdoor physical sculptures showing moon movements), we focused specifically on the metaphor of the local signpost and on the solar system as the general framework for the project. In its first iteration, we considered a signpost with multiple arms, each of which could be directed to specific objects in space in order to allow users to explore the relationships between them. The image below is an early concept sketch for this idea.

During an early discussion, the possibility of drawing on the digital information points now to be found in city centres also emerged. The idea of using these resources, rapidly growing in familiarity across the UK, was one that had significant resonance for the team, offering the possibility of diverse users outside science centres interacting with 'scientific information' through the same mechanism as local information about the city.

Early discussions with developers of these resources and with electrical engineers, however, identified significant costs both in the multi-armed signpost model and in using these infopoints as a basis for development. The decision was therefore taken to scale back the ambitions of this first phase prototype development to focus specifically on the possibilities afforded by the combined representational tools of a single moving signpost in interaction with
a digital interface. What was retained from this early phase development, however, was the metaphor of the local signpost and of the touch screen interface drawing on the model of local digital information resources.

1.2.2   Initial public survey: September 2003

The second phase of project development was to develop a broad understanding of public perceptions of the solar system, and of key areas likely to be of interest to a wide range of users. While we also drew on existing research in this area in formulating our questions (eg PPARC, 1999) many existing research projects focused on interviews collected with visitors to science centres and museums. In order to counter this tendency, we developed a short questionnaire that we conducted with a selection of individuals encountered in public spaces in Bristol over one day. In the first instance we asked people to let us know where they might want to visit in the solar system, what they might ask an expert about the solar system, what their views were on 'good and bad' areas in the solar system, how they might feel on winning a telescope, when they last thought about the solar system and the most interesting information they knew about the solar system. These questions were intended to elicit existing conceptions and perceptions of the solar system, and to engage with the affective dispositions of people towards this knowledge domain.

This process identified a number of key points. In the first instance, it became clear that when asked about a general interest in space, many people professed little or no interest. Further,
many people simply could not describe the solar system in any coherent fashion and there were a number of misconceptions (such as where stars could be found, what might be meant
by the phrase 'solar system', what planets were, how the earth and the moon moved in relation to each other). However, when we asked when people last thought about things in space, many people reflected that it was relatively recently, when they were outside at night.

When asked how they would feel on winning a telescope there was near universal enthusiasm and interest. This suggests that while people may not have a general interest in 'the solar system', there are specific areas of personal interest that they would enjoy exploring further (particularly with the aid of a telescope). The following quotes are drawn from these interviews, and suggest that for many people interest in this area is triggered by direct experience rather than a generalised more abstract desire to master a specific knowledge domain:

About three nights ago. A friend of mine was pointing out different constellations [...] my friend was pointing out the Orion constellation [...] billions of light years separating the stars and they are part of the same constellation.
I last thought about it, oh... Last night [...] I spend most of my time outdoors, so...
I saw Mars last night actually. It was really random because I was walking down the road and I asked this bloke for the time and it was really dark and he went, "there's Mars over there" and
I looked up and went, "oh my god". "That's quite strange," I thought.
I mean, I do sometimes look at the Moon on a very clear night and I think, ooh, it's interesting how you can actually see things on the Moon. I suppose it's the seas isn't it?

The main areas of interest in planets and space were in relation to their impact on life on earth, specifically, whether there was life on other planets and whether we would be able to
visit other planets or live on them. Pop-culture was clearly an important framework for thinking about space (which may explain the interest in life on other planets) and the X-Files and Star Trek were frequently referenced. Other cultural references, often for older interviewees, were greek mythology and english folklore (often in relation to the names of planets and stars, and reference to a 'harvest moon'). In respect of the idea of the project, there was general, if guarded and somewhat bemused enthusiasm - primarily for the idea of the provision of a resource about science that was free and in a public space. One striking fact that emerged was the speed with which individuals

shifted from a discussion of the components of the solar system, to profound philosophical questions

- Why are we here?
- What does it mean to be alive?
- Is there a god?
- Are we alone in the universe?
-

Indeed, the speed with which these questions emerged was often cited as a reason for not thinking about space, as it raised too many uncomfortable questions and feelings in the individual, which could not be resolved.

Well, the giganticness of it. It's so mind boggling, you have to wonder when it all started and [...] it's a very powerful thing.

As a result of this initial stage of the project, a clear emphasis was placed in the prototype design on the need to facilitate potential users' sense of engagement with other objects in space - such as, for example, what these places would be like to visit and whether there was life out there. This initial stage also highlighted a clear obstacle to the project's success, namely, the extent of confusion about the structure, language and meaning of different aspects of the solar system. This was so diverse that any tool risked increasing rather than overcoming misunderstandings. What this stage did encourage us to continue to explore, however, was the question of how we could develop a tool that was sufficiently open-ended as
to allow users to choose areas of their own interest to explore, rather than imposing a constraining structure of key information. It encouraged us to think about three distinct groups when designing the resource:

1. Those who have a high level of formal knowledge and want to explore their particular interests further.
2. Those who have a low level of formal knowledge and want to be 'told' more information.
3. Those who have a low level of formal knowledge and want to find things out for themselves.

What these interviews reinforced for us, was a need to develop a resource that could be used 'on location' outdoors, when people would be likely to use it to answer and explore questions that emerged through interaction with the physical space around them.

1.2.3 Focused interviews (1)

Following on from these informal surveys in the street, we decided to focus specifically on groups who are excluded (through education or income or cultural capital) from access to formal sites of science education, in which we include science centres. In order to focus specifically on this group we contacted a local community project (the SOFA project) which serves the needs of low income groups by providing low cost second hand furniture and electrical goods. This project also employs a number of people on New Deal, a number of people on community service (mainly young offenders) and a number of people with few or no formal educational qualifications who go on to manage and run significant parts of the operation.

Having identified that we needed to develop a resource to support those with low levels of formal scientific understanding of the solar system, we decided to focus these first stage interviews on attempting to capture people's existing conceptions of distance, size and relationships between objects in the solar system. We visited the project for one day, during which we worked with a number of staff, volunteers, clients and trainees at the project, asking them to carry out a number of different exercises

designed to elicit their understanding of the solar system. Each of these 'interviews' was audio recorded and photographed.

A number of key issues emerged from these interviews. First, the lack of confidence felt by many people with no formal scientific or other educational qualifications, in developing conjectures and playing with scientific ideas, particularly when they felt there was someone with significantly more formal understanding present. They were frequently concerned about making mistakes, often embarrassed when asked to guess answers to questions they had no understanding of, and sometimes refused altogether to explore ideas, saying simply "I don't know, I don't know anything about all of this". This contrasted markedly with other groups we worked with informally during the course of the study who, although with little scientific experience, were confident in themselves as educationally qualified, and were more happy to make guesses and conjectures in areas of which they were uncertain.

A second issue that emerged was the complexity of different strategies and understandings that different individuals drew upon in order to conjecture about the solar system. When asked to guess how far away earth was from the sun, for example, some individuals drew on a remembered understanding of the diameter of the earth and went through complex calculations to try to derive earth's distance from the sun. Others remembered something about the speed of light and estimated from that figure. Others guessed at the size of the sun, and used this as an indicator of its distance from earth. Others again drew on science fiction references. Many, however, were reluctant to guess and eventually said *"I have no idea, this looks about right"*.

When discussing the relationship between the earth, the moon and the sun, at least half of interviewees were not able to accurately describe the relationship, some placing the moon inside to and parallel to the earth's orbit, for example. One interviewee, a Somalian worker who had only recently moved to the UK, engaged us in a long discussion about the relationship between the earth and the sun, resolutely arguing that in Somalia (where you could see the sun, he said, with a wry smile indicating the grey Bristol sky) it was clear that the sun went round the earth. He described this as akin to travelling on a bus, with the houses looking like they were staying still while you moved. He argued that he would need to "*see it with his own eyes*" to believe that the earth went round the sun. What the interviews highlighted was the extreme difficulty of conceptualising the solar system as a three dimensional dynamic environment and of beginning to think about distances and scale of solar system objects.

One striking finding from this research was the high level of latent interest in the solar system amongst this group. Many said that they had no means of access to scientific information and resources apart from television, and that the cost of science centres and museums was prohibitive to them (even had entry been free, the costs of travel discouraged them from visiting). The idea that a resource in this area might be created that would be free to access and placed in a public site was of great interest to them. Indeed, even this short visit apparently generated high levels of interest in the project and in the subject area of the project. Supervisors at the SOFA project, for example, reported high levels of discussion of space in informal conversation during the day and for several days afterwards; they also reported that many of those involved in the interviews asked on several occasions when we would return with the first stage of the prototype.

1.2.4 Focused interviews (2)

Following these interviews and initial research by Adam Nieman, it was decided to use existing open source astronomical software (Celestia) to model the solar system in three dimensional space to enable users to conceptualise distance, scale and movement in the solar system.

Celestia is a well known open source environment for exploring astronomy but generally requires a mastery of astronomical terms and concepts before users can engage with it. It does, however, hold all the functionality required to create 'scripts' of particular ways of looking at objects in the solar system.

The second phase of the trials were to take draft scripts created in Celestia to model different ways of looking at representations of the solar system, and to refine these with potential users of the resource to ensure that they helped answer some of the questions and difficulties experienced by users in first phase trials.

We returned to the SOFA project for two days of trials, in which we had a paper version of the interface that we asked users to interact with in order to provide instructions to Adam who was controlling the Celestia system. We explored the questions that users raised during this process and the limitations of Celestia in helping users to make sense of what they were seeing on screen.

1.2.5 Subsequent prototype development

Following on from these interviews we created a series of requirements for Celestia and a draft user interface that would allow users to explore features of the solar system that they were interested in without having to have prior astronomical knowledge.

The first phase of the interface was designed with the three audiences we outlined above in mind and therefore needed to enable users to take a number of different routes through the system - as both playful explorers of the representations and as researchers of information provided 'on demand'. This led to a design that encompassed both playable tools (such as moving in or out from an object, or speeding up time to see movement) and information resources (such as a tour of the system encompassing an explanation of key features, and descriptions of the planets).

The need to allow flexibility in perspective clearly arose from the interviews we conducted which emphasised the number of different ways in which individuals come to think about solar system objects and the number of different solutions individuals use to make sense of them. The need to 'provide information' in a just in time manner arose from the number of questions of a factual nature that were prompted by our initial interviews.

One of the key challenges in designing Space Signpost's interface, was how to enable users to create a coherent picture of the solar system, without simply 'telling' them how it all fits together.

Drawing on our early interviews and exercises, we decided to employ the principle of juxtaposition in order to offer users a way of comparing other planets and objects with earth as the primary reference point. This juxtaposition would be in evidence both in showing relative sizes of objects and in showing distance and time to travel to these (a request that came up continually from interviewees). The hope was that this combination of user control of the interface, with information provided 'just in time', with juxtaposition of 'alien objects' with the familiar reference of the earth, would serve to enable a wide range of users to make sense of the representations we were offering.

2 DESCRIPTION OF FIRST PROTOTYPE

2.1 Signpost

The signpost consists of an LED screen mounted onto an 'intelligent' telescope base. A user selects an object that the signpost should point to and the signpost moves to that direction and indicates with an arrow either on the left or right of the display, the direction of the object.

The signpost displays the distance of the object in kilometres, and continues to show the changing distance of the object for as long as it is pointing at it. In practice, this means that the last three numbers (100s of kilometres) are constantly changing as you look at the sign.

2.2   Digital interface

The opening screen of the digital interface in this first prototype offered users a list of planets, the sun, the moon, and 'other objects'. The user could click on any of these objects to be taken to it.

On clicking on an object, the user is presented with a view of the object on the right hand screen and a view of earth on the left hand screen (both of these from the same distance to allow comparison in terms of size). At this point, the user can click on any of the other buttons at the bottom of the screen to explore the object further. This includes the Time control, which enables users to speed up time - this gives the effect of showing how objects move in relation to each other. This also includes the rotation and 'zoom' buttons (on the right-hand-side (rhs) at the base of the screen) - these allow a user to 'tilt' the object to view it from above or below, and to move in closer or move out to any distance.

The previous screen shows a 'zoomed out' view of Jupiter. On the left hand side we can see the earth and the sun on the right-hand-side we can see Jupiter and its moons. The blue lines on the right hand side show the orbits of any moons orbiting the object selected. From this screen, users can also select 'what is this place like to visit' - which provides textual information along with (where available) an image of the object's surface.

At any point, users can also select 'show whole area', which shows the orrery view of the solar system, users can tilt and zoom in on this image to see the orbits of planets from a number of different perspectives.

From the opening screen, users can also select 'other objects', which refers to objects which are not planets, the sun or our moon. This takes them to a number of different choices including asteroids, spacecraft and comets. Within this section, if they click on spacecraft, they are shown the spacecraft on the rhs and the path of that spacecraft from earth on the lhs.

If viewers choose to view earth, unlike any of the other planets or objects, they are able to move into a very detailed view from satellite of the earth's surface. This appears to move as they watch it, giving an indication of the speed of earth's movement.

Missing from this prototype were several features planned for completion. First, 'the tour' which would allow users a scripted introduction to the solar system, presented in a modular fashion so that it could also be accessed from other screens; a 'where is this object' screen that would show the location of the object in relation to other planets; and a 'how do we know this' screen, that would explain the basis for the information provided. All these were key features of the installation intended to be developed in this phase, but which have had to be delayed until second phase of the project due to time constraints.

3   FIRST PHASE PROTOTYPE TRIALS

The final version of stage one of the prototype was trialled over four days with 76 users in the Watershed Media Centre, At-Bristol, SOFA Project and Luckwell Primary School.

These early trials demonstrated significant potential of the system in encouraging engagement and confidence in exploring the solar system. They also demonstrated the potential of the resource to act as a cross between a 'toy' and a 'conversation piece'. The key features of the installation that supported understanding of the solar system were the signpost (and its counter-intuitive indication of objects 'below' earth); the 3D representational system that enabled users to view space objects from a number of different perspectives; the comparison of different space objects that began to allow users to conjecture about relative distances and sizes of objects in space
.

3.1   Sample

The research was conducted over four days in January 2003, with one day spent in each of four sites (Watershed Media Centre bar, Luckwell Primary School, the SOFA Project, Wildwalk @ Bristol). The sites were chosen to offer a wide range of potential participants in the trials, and in order to explore how the different sites encouraged different types of interactions with the prototype. All participants, with the exception of schoolchildren who were nominated by their teachers, were volunteers who were asked while walking past the prototype on location whether they wanted to use it.

Total number of individuals who trialled the software individually or in small groups: 76

Demonstration of software to larger groups: 2 x tourist groups, 1 x Year 3 class

Age range: 4-70+

Scientific expertise range: from primary school children recently taught about solar system, through adults with no formal educational qualifications, to education officers and researchers with higher degrees in scientific subjects. The average level of scientific qualification was high school science.
Employment range: from low income households with no employment and individuals on community service, to retired people, to highly-paid researchers and education officers in technology and education sectors, to students, to arts workers.

3.2   The features of the installation that proved useful in encouraging engagement and confidence in exploring the solar system

As outlined earlier, one of the key aims of the Space Signpost prototype is to facilitate confident and enjoyable interrogation of scientific representations. This section of analysis explores the extent to which this was successful.

3.2.1   The signpost

Throughout the trials, the signpost elicited a high level of emotional response from the majority of participants on initial use. Frequently occurring language included 'whoah', 'wow' and, most often 'cool' on observing the signpost move. The following are fragments of observed language that give some flavour of the emotional responses to the signpost and the changing numbers on the signpost indicating distance:

Whoah it's going... watch this, it moves... cool, that's a long way... Ooh, there it goes, that's a hell of a long way... ooooooh ha ha ha ha... It's going wheeeee like that... that's a long way...
That's fab isn't it... that's disconcerting... that's really foolish, love it... You should have a great big one... Fantastic... oh wow! Oh Wow! That's smart isn't it (giggles)... That is immense... that is so scary... wow that's wicked... oooh... it's billions of miles away.

What was clear was that the movement of a physical object that linked the user with an object many thousands (or billions) of kilometres away was a powerful way of initially engaging users emotionally with the concepts of the solar system. In respect of the Nuffield foundations injunction to "foster a sense of wonder, enthusiasm and interest in science", the signpost clearly achieved its objective.

The users as a whole, however, could then be split into three groups. A first group who continued to be primarily interested in the signpost:

G1 Oh, so that's finding Pluto now
G2 Oh, I didn't realise that's what that did - I thought it just pointed at Mars
G1 Wow!
G1 [with big smile on her face] I like that [pointing at the signpost] I really like that
K why do you like it?
G2 Because it moves... I'm simple [laughs] I'm simple and it moves... I don't know I just like the way it moves. I like the movement of the piece, cos it feels like its actually doing something.

A second group comprised those who 'toggled' between the digital interface and the signpost -finding the interaction between the two systems added value to both:

F It's partly the signpost and its partly the feeling that you can control, that you can see what angle you can see things from, get closer, get further, rotate around it... it's both of those.
There's something about the way it moves that's so very ordinary - its kind of clunky and makes a whizzing sound, and that connects you through the... one has a concept of space and that's ephemeral - the fact that this is so material, that you can look at that and think that the technology that's built it appears to be familiar - it makes it more real... it looks like Robbie the Robot. Metal Mickey.
K If you could see some of this on the web - would you be interested in something else - would
you be interested?
F Yes, but I don't think - looking at stuff on the web is very removed from anything isn't it - but this isn't, so its different, so what makes it different it has very... On the whole anything you find on the web, I'm disengaged from it, but this isn't, this is engaging.
And those who ignored the signpost after the initial phases of use and focused most of their attention on the digital interface, sometimes even finding the signpost a difficult distraction from the screen:
M I think it's very impressive, I think it's very good, to have the little thing pointing like that.
Not much point in that really, but I think it gets you into having a look at the rest of the program, if you've got that thing going there.
I think it's really good this. I think it's almost a bit much having both [pointing at screen and sign] in the same time, because there's so much on the screen, so it's quite hard to click on there and then have a look, it's almost like they should be two separate things. You could do one and then the other... possibly... I don't know, there's quite a lot there.
I would use it, just for a laugh, and then probably realise it's actually quite interesting, and then realise you can zoom in and pan around the planets and stuff. I think this [signpost] is more of an attention grabber, and then it draws you in.

3.2.2   The digital interface

The digital interface (setting aside certain issues of interface design to be described below) seemed particularly successful in encouraging engagement and confident 'play'. Several features were notably successful:

1.   The humour of the headlines

On reading the headlines, many users laughed and joked and used these to stimulate other comments. The irreverent nature of these headlines seemed to help get users 'on side', and help them feel that they were part of the community of users intended by the installation. It may be worth further exploring how this humour can be retained without some of the more extreme flights of fancy in the current version (eg Beagle stolen by Aliens...)

2.   The experience of travel through space and time as the interface moved to show another object

The representations on the screen that showed the movement from earth's surface through space to finish up looking at the object were particularly engaging for many users, some described it as space travel, one user described it as being similar to out of body experiences she had had. The language used by users suggested close engagement with the experience - usually using first person and present participles, suggesting a projection of self onto the screen movement:

I like the way all that happens (the movement between the planets as you travel to a new
one) yeah, it's like 'whoosh'.
Oh, we're flying straight into the sun [laughs].
I wanna do that galaxy thing again... it's very absorbing and you want to know more -
you
don't want to stop - just to be in the solar system, it would be... it is amazing.

3.   The reference to concepts familiar with most users, such as weight and sunscreen, in the information screens

The information provided in the 'what is this place like to visit' was written in such a way as to allow users to link the information to their personal experience. The references to weight on the planets, for example, were particularly popular and the apparent contradiction between the temperature on planets and the requirement for sunscreen provoked discussion.

What I liked about this was that the facts you got were like really interesting without being overly serious and in depth, like the stuff about the weight, about how much you'd weigh there, that's just so engaging.

The weight stuff - I just can't believe that you'd be a pound if you lived on Pluto! And all the temperatures and things because you sort of have this notion that it would be a totally different environment from earth, but I don't think you have an idea just how different it would be. And also, are they - the Voyager - are they like man-made satelites? They're just so far away, it's incredible.

4.   The diverse ways in which users could control the screens - allowing playful exploration through changing distance of view and angle of view

The buttons allowing users to move in closer to an object or pull back to an almost infinite distance encouraged users to both play with the objects on the screen and to play with the interface itself, exploring just how far it would allow the user to control it.

These interactive features seemed to offer users a sense of power and control, not only over the system but metaphorically over the planets.

Oooh, that's very pleasing. Wow [as the images on both screens enlarge - she then plays with
moving in and out and with rotation buttons for five minutes].
That's how fast... we're going in time... where the earth will be... I am moving the earth, I am
moving the sun.

There were also some notable instance of users exploiting these features of the interface to create a narrative control over the representations, effectively 'making stories' out of the images they were controlling and attributing emotions and thoughts to the different objects.

B2 Oooh - that's all the moons, all those blue lines are moons... so many moons
B1 [looking at lhs] There's earth and there's the moon
B1/B2 Ooooh I'm going to crash into Jupiter... The man's thinking 'why is the moon turning all
over the place'
B1 All those lines - they're the moon
B2 [as they zoom in] We're going to crash into Jupiter - aargh
B1 Let's go to Starter [Saturn]
B1 That's one of the ones with the round thing round it...
13
B2 Tell me where to go
B1 Let me see know - is Jupiter is it going to fall or is it going to land on earth
B2 Go like that, go like that, that's how I want it.
The following example shows a particularly enthusiastic user engaging closely with all the
features enabling 'travel through space'.
F Ooh 'Ha Ha Ha Ha' - watching it move...
F And it's
F2 Quite a long way away
F Four thousand million miles away [laughs]
F2 It's getting closer
F No, it's going wheeee, like that
F That's a long way
F [clicks on something else] Oh wow - look look look - that's nice
F So that's halle bop comet - what do these do?
F Does it make it bigger?
F [sharp intake of breath] Wow - it moves it
F2 That's cool
F Mmmm rotate up, should be able to... move back
F2 That's fab isn't it
F What does this do?
F2 [laughs] I think you've just gone into a black hole
F Oh no - you see
F2 Ohh wow
F I'm on the interior of the comet - hee hee - you see
F2 [laughs]
F Now let's go round and round and round and up and down.

For almost all users, the Space Signpost prototype achieved its objective of encouraging confident and playful exploration of representations of the solar system. In many respects, the Space Signpost prototype can be compared with a toy that encourages play and facilitates users to project onto it their own ideas and conceptions of the solar system.
One exception, however, was a young female artist who was clearly left cold by the experience. She described the installation as "too sciency", and said that she simply

wasn't interested in it. It is not clear how the installation might be redesigned to encourage her engagement, although there was a suggestion that the colours and style of the interface too closely resembled scientific instrumentation.

3.2.3   Engagement in isolation or conversation?

It is worth noting, although we did not explore this area closely, that there were different preferred styles of interacting with the resource. Some users clearly enjoyed working with other people and felt that this enhanced the experience:

I really liked it, I found it really interesting, it was really nice when you had another person there to help you out and be looking at the information. Plus, it's just that whole thing about communication, like me saying to [...] "oh, look what that is", whereas when you're on your own you can take it in but you've got no one to share it with. I think it's really interesting
.
Others preferred a silent and personal journey through the installation. The question of how we can design the resource to enable more than one user to explore it at any time remains a moot question. In particular, when working with the primary school children there were battles over who had access to the mouse and resentment at not having control. At the same time, however, when there were multiple users, we often saw them taking on different roles - with one person reading the signpost while another focused on the screen, or one person 'driving' while others directed. Given the signpost's potential location in a public space, the issue of how many users will be expected to watch/control/participate at any time requires further exploration if we are to ensure that the installation remains engaging.

3.3   The questions users brought to the installation and which were generated by users during use

3.3.1   Routes as a guide to areas of user interest

By tracking the routes taken by users through the interface, it is possible to identify the features they were most interested in exploring. What is noticeable, however, is the very wide range of different routes taken through it, which leads us to be cautious in any conclusions we might draw from this analysis as to the pre-existing questions users brought to the resource and our success in enabling users to answer them. Of the 24 routes we were able to track, we saw certain patterns emerging - for example, a high level of interest in spacecraft, in Mars (unsurprising given recent media coverage) and in both the exotic and distant 'Pluto' and in our local and familiar Moon. Neptune and Uranus, and the headlines offered on the screen, were only rarely explored by users.

In terms of the questions that users brought to the resource there are a number which could not be answered by the existing content and which we describe below in terms of areas that require development.

3.3.2   Questions and observations related to content generated by users during trials

What is perhaps as interesting as examining the extent to which the software is able to answer users' existing questions, is whether the installation in fact generates questions about this area through use. In our preliminary studies, for example, we had found that (other than questions about life on other planets) many people were at a loss to formulate questions that might be of interest to them about the solar system. From

these trials, it seems that the installation can serve as a 'scaffolding' resource enabling people to formulate more specific questions and areas for exploration than when thinking in a more abstract fashion about the solar system.

The following are a number of different questions generated by users about the solar system while using the prototype, these range from questions about the origins of scientific knowledge, to questions of how space technology is disposed of, to questions about the nature of planets and the solar system:

How do they know it [Jupiter] doesn't have a surface?
Would that crush you? Would you be strong enough to walk on the surface? (visit Jupiter screen).
Find out where Halley's comet is at the moment then.
When's the next time it comes round?
About sixty years or something?
Let's go to Mars - apparently we're all moving there in 2030 aren't we? How are we going to live on Mars?
Are they all the satellites? What's the Friendship? (on the orrery screen).
What happens to the old ones [satellites] when they're done, when they don't want to use them any more?
Where do the names come from?
Have they stopped building that [ISS] now that the Americans can't get up there? Cos I haven't heard of anything going up there lately.
What's the speed they are going round?

3.3.3   Eliciting existing knowledge

During the course of the trials, users also often volunteered information that they were previously aware of about the solar system. When there were multiple users, we often saw conversations starting that moved away from the screen to enable one person to share understanding and ideas with another. As well as a toy, then, we might conceive of the installation as that old-fashioned device, a 'conversation piece':

Bloody hell - Voyager's never that far away
Yes it is
Is it hell, I can see it with my binoculars
No, not Voyager, the space station...
I guess its because Hubble's found them [Jupiter's moons]. They're going to burn Hubble... they're just going to 'splat' - drop it.
This is Pluto, at the moment it's not the furthermost planet, it's inside Neptune, it's actual orbit goes inside Neptune so it's not actually the furthermost out... It's an actual fact that every seven or eight years it isn't the furthest planet out because it goes inside for a little bit.
Go to Mars and see if there's something on Beagle Two, cause the American one landed
there... Not our Beagle... it's balloons didn't open... weird things like that.
So the question is - do you believe they actually put someone on the moon?
Er that's an interesting question
If you look at the old rickety spaceships they were using and the radiation and those dead astronauts that come up mysteriously and got killed and stuff
Oh right
And the flag flapping and no atmosphere... it's all a bit suspicious if you ask me.
This might be correct actually - cos the way maps are perceived, these continents are actually much bigger - Africa, South America - you know the way you've got a map of the world and
America is as big as South America. It's all wrong, cos Africa is huge, the continents are just much bigger than what they are conceived on conventional maps and stuff... It's cos most of the action happens in Europe and America and stuff... But as far as landmass goes...

Aha, smug American lands robot on Mars [laughs]. I reckon they've done pretty well, caos all we've got is a Wurzel that's on ours.

The installation, however, did not only trigger conversations relevant to conventional scientific information, but seemed to allow some users to return to thinking about more philosophical or spiritual matters:

Did you see the eclipse?
I could see it through my window - it's amazing, it's so beyond our field of reach, but it affects us... Hundreds of years ago, thousands of years ago, people would have been terrified by them.
It's mindboggling...to travel that distance, if you could survive the machine to take you there... if you still had a machine that travelled at the speed of light, you'd still die of old age before you got there.
What other objects do we have?
Black holes or something
What about hell?
It's kind of scary.

3.3.4 The role of the different representational features of the installation in aiding understanding

While engagement and interrogation of different representations was a key objective in the design of SPACE SIGNPOST prototype, we were also interested in exploring the extent to which the different representations could act as 'tools to think with' about the solar system. This section will focus specifically on the extent to which the different representational features of the prototype offered more or less fruitful ways of thinking about the solar system, whether it offered users useful tools for conceptualising the often abstract notions of three-dimensional and dynamic space.

3.3.5 The signpost as key feature in changing perception of space from two dimensional to three-dimensional

From these trials it seems that the key contribution of the signpost to users' understanding of our place in the solar system is in providing a tangible representation of the earth and the solar system as three dimensional. The most frequently observed moment of surprise during the trials was the point at which users were confused by the signpost pointing downwards through the earth to another object in space. As one user described it, many people's previous experiences of representations of the solar system are two dimensional and static:

To me GCSE {high school} science is a two-dimensional diagram... this is three-dimensional, these diagrams are three-dimensional... At school, well it was the picture - the sun's here, and the planets here, all in a row on a piece of paper...

In contrast, the movement and direction of the signpost, for at least half of the participants in the trials, offered a 'tool for thinking' about earth and space that enabled users to think outside their normal frame of reference of the earth's surface, and to locate themselves, and earth, as being 'inside' rather than 'underneath' space. The following examples highlight this process:

What's kind of surprising is that instead of being up there [pointing to the sky and above head], because the stars are all kind of up there, that they're over there or there [pointing I front and below] you get the sense of earth being kind of like a round thing [making sphere shape with hands] instead of... completely flat... which I know is kind of obvious but you don't really think about it, you think the sky is kind of up there.

S2 Yeah, like when we clicked the moon, it took me a few seconds to realise why it was actually pointing like that [pointing down] - I thought it should be up there [pointing up] – and then [laughs] I was like 'oh wait a minute'
S1 Why is it down there?
S2 I was thinking yeah - it should be in the sky! And then I was like...
S1 I was like that with the sun - I thought it was up there and then we looked at the sign and it was over there [pointing relatively horizontal and low in the sky].
A: That was a surprise, when it pointed down and I was like [looking at the sky] - it's not just
up there [laughs]
K: Is that kind of sciency or is that something you enjoyed knowing?
A: It was something I hadn't kind of thought about before... But [smiling] it's like blindingly obvious - cause you always think of the sky as up.
M: No - I always expect them to point up, but they don't, they point down, because of the position of the earth... it makes you appreciate that you're on something that's in constant motion - I mean we take it for granted don't we.
M It tells you how far away it is and where it is... but I would never have imagined that the
Hubble was down there [pointing down]. You wouldn't think of it like that would you - cos it's the other side of the earth
K Cos normally if I said like 'where are the planets and stars and something'?
M & F point upwards
M You'd just say 'up there' wouldn't you
M [laughs] You learn something new every day.
G2 You do forget that the sky is [making round movement] that way don't you
G1 Yeah
G1 Yeah, cos you just think 'oh' [pointing around]
G2 It does, cos you're looking in relation and it makes you think that it is actually... the world's
round and not flat [with a wry smile]
G2 If you get what I mean.
[sign moves and points down]
[M looks confused for a while, and looks round at the sign and then at Adam]
M Is that Australia or something?
[silence and looks for a while longer at the sign, no comments and no clicks on the interface until, after some time]
M It's just pointing through the earth, it's below the horizon or something.
K So there's Saturn
M2 So I have to dig that place down
K So does that make sense to you that it's pointing down?
F1 Does it mean, does it... er?
M2 That's the way to Saturn
M Underneath the ground
M2 You have to... it means it's on that side... it's that direction...
M2 To me, it's OK...
K Do you think that's a bit weird
F1 It's a bit weird to me
M2 That's the way, that's the way - the earth is spherical shape, this side to you, this way to me. The different way you get to Hanam, when you go to Hanam - it's like the Moon.

3.3.6 The signpost providing a tangible connection between flat earth and threedimensional solar system

The signpost also offered some users the opportunity to link their conceptions of physical space on the surface of the earth with physical space in the solar system. In particular, in trials at the SOFA project, users often commented on the features of the local physical neighbourhood and viewed them as routes towards solar system objects.

M2 She says she wants to know what that means [referring to the numbers on the sign]
K OK - it says it's 191 million kilometres in that direction
F1 To Mars?
K To Mars
F1 From Earth?
M2 So if I take my car and head for Lawrence Hill... [laughs] and keep going!
M2 Quite a long way.
S This is Mars - let's try something a bit unusual... nope, maybe better click - [signpost starts moving] oh wow... So if I followed that trajectory in some kind of space vehicle, I'd get to
Saturn?
K Yep
S & J [laughs]
J OK, well, your vehicle's out there [points out of the window] so... [laughs]
S [laughs]
K What's that? The bike?
S Yeah [laughs]
K Could take a while
J ET can do it.
[signpost points to Voyager]
N Woah - that's pretty long that I reckon
J 13 billion km
J So, past the pub, past the flag, it's just over the green somewhere [laughs].

These comments did not, however, emerge in any other research site and as a result it is difficult to conjecture about what triggered them. The most obvious explanation is that the
SOFA trial was the only trial where the signpost was on street level and in easy view of 'the real world' outside. If this is the reason for these connections being made, it provides some cause for optimism that the location of the installation outside in a real world setting would serve to encourage these sorts of connections between the three-dimensional solar system and the perceived flat surface of the earth. This will need to be explored in the next phase of trials.

3.3.7   The digital interface as key feature in changing perception of space from two-dimensional to three-dimensional

As described above, the most common representational tool for thinking about the solar system is a two-dimensional static image of the planets in a line moving out from the sun. The dynamic three-dimensional imagery on the digital interface seemed to play an important role in providing a powerful alternative representational tool that enabled users to conceptualise movement, distance and the multiple dimensions of space more easily.

There's definitely a lot I didn't expect to see cos I've never had a chance to see it in that kind of perspective, cos when you see the solar system in a book, it's kind of hard to get an idea of the scale of it, whereas that's a really useful tool to get some kind of comprehension of the distances, whereas that's amazing, yeah, very impressive.

It's cool to be able to see the differences in the sizes, and to be able to flip it like that [demonstrates tilt on the orrery screen] to actually see the different... You normally only see it in one view.

Relative to what it all points to... it's kind of um... it's like, supposing it only had a back of the envelope scribble on the map to someone's house compared to an aerial photograph that had all the surrounding houses and it gives you a sense of how to get there and how it fits in with the other streets.

It gives you an idea of depth of where things are... Like earth, you think it's flat in books, it's nice to feel that kind of density/matter...

What several observers noted, however, was that it was sometimes very difficult to link these new three dimensional representations with their previous 'top down' static view of the solar system. Many users noted that it would be useful to be able to link all the different objects together, to pull back from one object to see its location in relation to other planets. This had been intended as a feature of each object screen, but unfortunately this feature was not ready in time for the initial trials. Moreover, the feature that might have assisted in this linking (the 'show whole area/orrery' screen) was unreliable for three of the four days of the trials. This question of how to link a three-dimensional dynamic representational tool with pre-existing two dimensional static tools will act as a key feature of next phases of development.

The point made earlier about how the rotation works is relevant here also. The ability to move around the model is vitally important to understanding its three-dimensional nature. As mentioned before, there are few distance cues in the individual frames themselves - just lots of confusing intersecting lines and isolated objects. The most powerful distance cue in human perception is motion parallax, which is the way things in the distance appear to move more slowly than things in the foreground as one's point of view changes. Moving round a complex collection of overlapping orbits (eg the moons of Jupiter or the orrery view) allows us to perceive them as paths through three-dimensional space. Without moving, this is extremely difficult to represent. If the way rotation works causes confusion then the ability to perceive the scene in three dimensions is seriously damaged.

Seeing a static view of an object in correct relation to its neighbouring objects would not be enough to give users a sense of its location in three-dimensional space. The user has to see all the objects from a moving perspective and, preferably, be in control of how the perspective moves.

3.3.8   Comparisons and juxtapositions

One of the features that we intended to act as a resource for thinking about the solar system in Space Signpost was the juxtaposition of different objects with each other and with earth. In some cases this seemed to work particularly effectively in giving users a way of thinking about differences between planets. For example, the information about relative weights on planets stimulated a number of conversations:

Ooh, listen to this - gravity is 2.5 times that on earth [on Jupiter] so a 10 stone person would weigh 25 stone 1 pound - in Pluto you would weigh a pound.

The changing distances represented on the signpost also seemed to enable users to compare different planets/objects' locations and to trigger some people towards experimental techniques where they would ask a question, conjecture and then move the sign to test their idea:

I wonder how far Pluto is?
How far was the sun?
There's no billions any more [looking at the sun].
Click on the sun
Read the distance and then check where the sun is in relation to them [looking out of the window]
Click on earth - read the distance and laugh
Click on Voyager
Whoah - that's pretty long that I reckon.

One unexpected comparison that emerged during use, was the decision by a number of users to pull back further and further from the sun until it looked exactly same on

the screen as any other star. Given that it is very difficult for people to conceptualise the sun as a star from their day to day experiences, this feature seems to have some potential worth developing.

It looks like a star... like a tiny spot [referring to drawing back from the sun]
Like the others, just like a star.
We also saw users moving between different objects and commenting on relative sizes as they did so:
M [looks in detail then clicks on Eros asteroid then stands back and watches the sign; then pans out] Ah right, of course, it's really tiny isn't it [then clicks on Gaspra and watches the sign with attention - again, zooms in and out]. This one looks like it's bigger doesn't it [zooms out].
You can still see it there, that must be South America [then clicks on what like to visit, then clicks on Ida and Dactyl]. This is a big one as well isn't it... this is a very big one [zooming out]. (S5)
N I want to see the craters on the Moon
J I've never ever seen Pluto. Whoa... [as view moves back]
N There it is [reads distance on signpost]
J So how big is it in comparison with the earth? [pulls back out to see]
J So it's basically like the core isn't it [about Pluto in relation to earth]
N Well it's kind of like the earth in relation to the sun
K Is it?
N Go back out - go to the sun
N That's the sun compared to earth
J That's a surprise.

Another unexpected juxtaposition, was between the digital representations of size and users own experiences in observing objects such as the sun and moon in everyday life:

When you look at it in real life, it doesn't seem like it would be that big.
Look's quite small really.

A key feature of Space Signpost was intended to be the constant comparison between earth and the objects selected. From our study, however, it was clear that there was a serious problem with our interface design as most users were unaware that what they were looking at was the relative sizes of earth and the other objects. This may have been because their existing conceptions of the size of some objects meant that it was counter-intuitive to them to assume that these were comparisons. Clearly the interface was lacking in this area.

Oh wait - I just realised the pictures were relative - I didn't realise that until now. We checkedout a few planets - but didn't realise that the sizes were relative - because you can zoom in and out. Maybe if you could have 'relative size comparison' written at the top
.
When we did point this out to users at the beginning of the trial, however, it was clear that this comparison has the potential to act as a powerful tool for thinking about scale:
A One of the things that nobody has noticed so far, is that the picture on the left is on the same scale as the picture on the right, so that's earth and the sun on the same scale
F Bloody hell - wow that's wicked
F [clicks on Venus] Wow that's similar
F [clicks on Mars] Ah, Mars is quite small then.

It is worth noting, however, that the design of our study did not allow us to explore the implications of these tools for users' conceptions of the solar system. It was only through verbalised discussions of relative size that we captured any of their understandings in this area.

3.3.9   The competing representational systems of signpost and screen

One key issue in the design of Space Signpost that caused confusion for some users, was the relationship between the signpost and the digital interface as representational systems. The 'time' buttons when linked with the ever-changing numbers on the signpost, for example, were particularly confusing for some. The key issue here appears to be that some users expect that if the digital interface controls the signpost in terms of object to point to and direction, then it should also control the signpost in terms of the time at which the signpost should point to the object (in other words, that if you speed up time to look at objects on the screen, then the signpost should also show the change in time).

S2 Have you got it on high speed cos that keeps changing [pointing to the numbers changing
on the sign]
S1 Yeah probably, yeah, is that [pointing to numbers changing on the sign] the wobble, yeah,
it must be
S2 Is that on fast?
S1 Yeah it's on fast
S2 See if we put it on now - normal - it shouldn't change
S1 Do you reckon it's changing that way anyway
S2 Normal speed
S1 Must be travelling - it is going up - so it must be travelling away from us
S2 But we put it on fast [they both turn back to look at the screen] - put it back to now and it should jump back to what it said initially, before you put it on fast
S1 And at normal speed
S1 So that means it's travelling away from us
S2 But it didn't jump back to where it was see
S1 But it's going up - at like, 25 miles a second, so it's travelling away from us at 25 km a second
S2 But what I'm saying, like, is that when you put it on fast speed it suddenly went up by about 150k a second, and I expected that it would suddenly jump back like when you put it to now, because that's surely looking into the future
S1 So if we put it on fast, then it should go up faster
S2 Yeah it is - yeah, more than 25k a second - can you make it go faster still
S1 No, it's still the same
S2 See if you put it to now
S1 Has it gone down [both laugh]
S2 I dunno - that's my theory out the window then.
M1 That's how fast... that's 41 noughts...
M2 We're going in time... where the earth will be...
M1 Look the numbers are going up [looking at the sign]
M2 I am moving the earth, I am moving the sun...
M1 Oh - the number's changed - see we're still going further away from everything...
[Then they click on something and the signpost moves]
M1 That's amazing... that is so cool... that is immense... that is so scary [while giggling]
[They are worried that if they turn the speed up that they will speed up the sign]
K Did you notice why the numbers were changing on the signpost
M Because of the different distances where certain obejcts were
K If we have a look at this - you see the last numbers were changing
M Yes... all of that yeah
K Why would those last numbers be changing in relation to Mars
M Just as it finds its bearings [the signpost]
K But it's still moving now though and it's found it's target
M Its just the few last kilometers and we're moving as well.

For another user (N below), however, the signpost pointing below the horizon provided real problems. What is not clear from the discussion that took place around the signpost, is whether his difficulty lay primarily with a lack of clarity as to how the

signpost itself works (ie where it measures 'from') or whether his pre-existing concepts about space precluded him from thinking about the solar system and earth from another perspective in which objects being 'down' was unproblematic.

N Why does that tilt that way? [pointing at signpost pointing down to earth]
J Cos that's where it is, that's below us really, its just er, due left of Australia if I'm correct
K Do you understand why that's down there?
N No
J It's pointing to the direction, where it is
K Where are all the stars and the planets, if you had to point to them now, where would you point?
N Up
J Yeah
K So why's that there?
J Cos we're probably in the centre of the earth, if you were on the edge or something it would
probably be pointing down
N Ah, cos the earth is round innit, well, it ain't really - it looks straight dunnit
K So the earth is round - so what's around the earth?
N & J Atmosphere
K What's round that?
N Space?
K So if you had to point to the stars and the things in space - if you think of us being round - where would you point?
N All around us?
K All around us
N Uh OK - all around
J So wherever we point it could be there right...
K So if you imagine - this is us - [making globe with hands] so if this line carries on it goes through the earth and points out the other side below us
J Uh OK - I got you
K Cos the stuff could be all around. You might want to go back to earth. There you go – pull back
N So it's probably here or something [pointing to the right into space]
N So where is the core then?
K It's around the middle then
N Cos I watched the Core, I've got it on DVD and stuff and it's pretty cool.

4 NEXT STEPS AND FUTURE DIRECTIONS

A number of interface modifications were required as a result of the trials of this first prototype. Additionally, the design of this prototype meant that we were unable to study its use in the site for which it was designed - outside, and in the way it was intended to be used - without any researcher intervention. In order to address these, and to progress the project further, COPUS were approached for funding for the second stage of the prototype. A major award was granted for the revisions to the interface, and the development of a robust installation for use in a permanent site on a city street, is now nearing completion. The signpost has been erected in Bristol and io operation from January 2006. Adam Nieman is now in discussions with NESTA I&I team and is developing a wide range of potential applications for the 'Space Signpost' (as Welcome to the Neighbourhood is now known)

5 CONCLUDING REMARKS

From the dialogues above it can be seen how it is useful to engage in meaningful and extended dialogues with the potential users to design and improve the design of public information systems. Equally because we see a diverse age and ability audience for the signpost we had to conduct research with different generations and types of users. In this case direct dialogue was chosen as the main research methodology as we wanted to collect rich conversational and emergent patterns of understanding that could not be achieved by fixed questions – which did not allow for follow up and further illumination – nor observational methods - which would not have revealed underlying assumptions of the users.

The Signpost is now erected and we will be able to undertake further user research. As part of the continuing La Piazza activity we will design new interactions and activities around the signpost – which is sited in a large public square.