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Infinite Infants & Telematic Playspaces: Presence and Pretense

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Abstract

Infinite Infants is a three-year research project exploring the potential for sensory, networked and representational digital technologies in early years education. The research considers Mixed Reality (MR) as a potential agent in the context of collaborative and active learning spaces. This extended abstract presents the conceptual framework for research and design practice, formative development and summative findings.

1. Introduction

The Infinite Infants project was initiated in September 2005 by three local headteachers, in collaboration with the University of Plymouth. Initial expectations looked for an expansion of ICT for everyday early years learning. Of particular interest was the application of digital technologies that were less constrained to the desktop, and encouraged social learning. Further was a request to develop systems that could integrate with existing teaching methods. The Infinite Infants project therefore gave way to a research opportunity to consider the design, development and study of the use of collaborative Mixed Reality (MR) spaces within the context of education.

The target age group for research is children across the Foundation stage, Key Stage 1 and 2 (ages 4 - 7). Engagement with technology is focused on physical action and communication in co-located virtual and physical environments. Although research spans all aspects of the curriculum and teaching processes, the applied design practice adopted sociodramatic play as a vehicle to investigate digitally mediated social dynamics, use of artifacts and spaces, through a familiar learning activity.

The broad objective of the interactive playspaces is to support multiple users in a single environment, to enable co-located and remote collaboration. These have been growing modalities in co-present entertainment, such as the Wii, and extensive in online social computing systems. The research aims to understand what role these modalities have to play in learning for young children. There are three directions for the research project, to explore the two dimensions of physical action causes digital effect:

1. To augment reality - bring the digital world into the physical
2. To augment virtuality – bring the physical world into the virtual
3. To network between remote locations

2. Design Frameworks

Active and collaborative learning is an established pedagogical framework, particularly in early years education [13, 14]. The *active learning* approach stresses that learners acquire knowledge while completing tasks requiring higher-order thinking, particularly when adapting to new environments [13]. Developmental psychologists have long recognized the parallel development of thought and language, and thus the value of the social environment in learning [14, 18, 19]. Play, while not the predominant feature of childhood development, is a leading factor of cognitive and social growth [2, 8, 17, 18].

For design and evaluation purposes, embodied and distributed cognitive theories underpin the study of the relationship between humans, and frame the role of technology as a tool that partially mediates those relationships [5, 9, 12, 15]. Distributed cognition enables a breakdown of socio-technical systems in context, and helps derive how a system provides situated awareness through symbolic feedback, language and action [9].

3. Design Practice

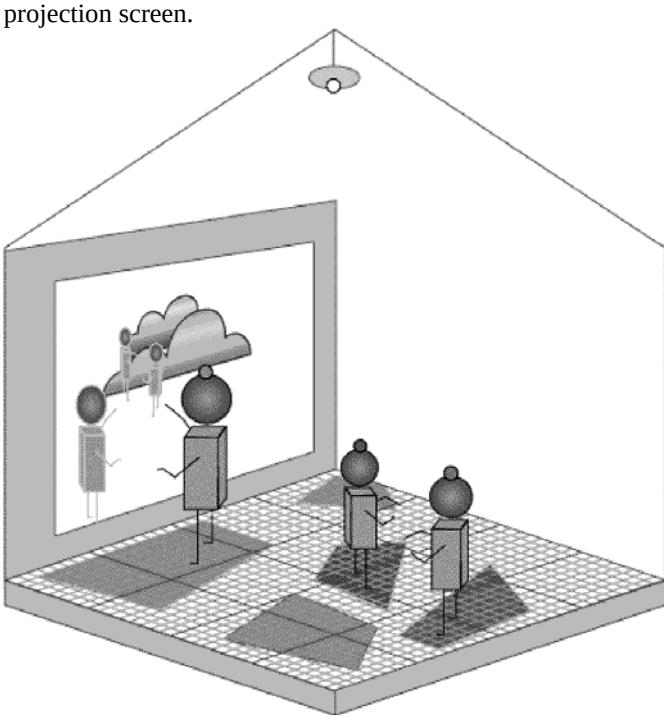
Partner schools have provided an environment for discussions, observations and evaluations of theories and technologies. Qualitative data from the field spans observations of classrooms, lessons, meetings and collaborative activities, learning spaces, interviews with children and teaching staff.

The design practice is informed by user-centric HCI approaches to design and evaluation. The research activities have incorporated techniques developed through similar projects [1, 3, 4, 7, 11] especially those developed by Alison Druin and colleagues at Maryland University termed *Cooperative Inquiry*. Research activities include participatory design sessions with the children and teaching staff, where in addition to observed behaviour, data included work produced by the children and peer observations of task. The development phase to date has included approximately fifteen design workshops, working with children between the ages of 5 – 7 years in groups of eight to four participants. Workshop sessions have either used low-tech equipment (paper and pens), existing software, and research prototypes.

The initial research looked for evidence of active and distributed learning in schools. In role-play spaces, the children are encouraged to enact on knowledge gained in taught lessons. The design of the space and objects placed within it, provide a tangible context for children to gain an active understanding. Artifacts distributed in the playspace, shape the context of the play activity and support presence in the imaginary world. Through interacting with objects and the space in play, the children explore their own understanding and knowledge, and share it with each other through dialogue and action.

The design practice aims to provide authoring tools to augment physical spaces with representational media. Authorship of personal stories is an important feature of storytelling for young children [1, 3, 11]. It is often their first encounter of sequential structuring; with the narrative providing a framework for intention, cause and effect for a series of actions. Consciously or not, even the simplest of stories can involve complex spatial, temporal, physiological and cultural concepts [17]. Moreover, in play, 'things lose their determining force. *The child sees one thing but acts differently in relation to what he sees. Thus a condition is reached in which the child begins to act independently of what he sees.* (…) In play, thought is separated from objects and action arises from ideas rather than from things' [19]. If the children can create their own augmented spaces in deciding how the environment responds to physical interaction (motion, location), the computer is used as a tool or place. Therefore agency shifts from the computer to the learner - the learner is directing the process, rather than being directed.

The application suite currently comprises of software written in Macromedia Director, Quartz Composer and MAX MSP / Jitter, and is installed on a Mac Mini Core Two Duo. The Mac Mini runs dual-headed via a Maxtrox Dualhead 2 Go, feeding on a SXGA Touchscreen and a XGA projector. A USB microphone provides the audio feed, and two IIDC compliant firewire cameras are daisy-chained to the Mac mini for video input. One camera is situated to supply a plan view of the space for motion tracking, whilst the other camera is situated at (children's) face level view next to the projection screen.



The suite of applications include an *Audio Spaces* tool that enables augmented audio layers within the playspace, to effectively paint the physical space with sound. This creates a single shared audio environment that can be used collaboratively by the group. Users can mark out areas of the playspace via the touch screen using the plan view camera, and assign (select from drive or create ad hoc) a sound to each area. The sounds are triggered when users physically move through the defined areas.

The second main prototype offers a range of visual effects to be applied to the live camera feed from the side of the playspace. The live video is placed over previously recorded video or found footage, using chromakey, and is projected. There is currently a blue screen in the playspace to extract the background, however this function will soon be superseded by a static image of the background within the system, to ensure a more defined chromakey area. Alternatively, the live video can be manipulated and viewed in a different artistic style, such as cartoon.

The software developed for the interactive playspaces are still tentative prototypes, but function well as research tools to explore the *virtuality continuum* [10] of MR environments. It has been important to evaluate whether the children can connect their physical action to digital reaction. It was predicted, based on prior work [16] and early observations, that children would find this 'cause and effect' unfamiliar. However for the project to be successful, it is

critical the representational media finds its way into the play narrative, as the objective is to augment a space with representations from a personal narrative as a means of sharing it with others. It is hoped visual and audio generated by software can provide a situational awareness that would be reference in language and action.

4. Summative Findings

At this stage, findings from fieldwork are feeding into an ongoing design practice; whilst research also theoretically explores the influence of MR spaces on collaborative perception and action. In all formal classes and participatory design sessions, observations looked for patterns of social interaction, use of space and tools / artifacts in collaborative activities. Sessions were either video recorded and transcribed, or documented using notes and photographs. Analysis focused on language (verbal and non verbal) and action, looking primarily for intention and development of narrative. Sessions were concluded with short open discussions with the researcher.

Presence in sociodramatic play is marked out through intention in dialogue – acting in character, as opposed to planning and organizing. When engaging in prototypes developed for the interactive playspace, presence was denoted when representational media (projected image / sound) or interaction was referenced in the play narrative (dialogue, mood, context), or reflected in the action. Social presence was marked out when more than one participant co-existed in the same narrative space.

4.1. Distributed Interaction

The research found social interaction in playgroups to be highly fluid. The dynamics of the groups would continually shift from collaborating as a whole, to small groups, dyads, and even to solo play: creating and dispersing multiple narratives in the same playspace. This observed behaviour supports the early design work, which enables the physical environment to be the interface, where interaction is distributed throughout the space.

Single points of interaction generally caused conflict among the group, with resulting disruptive or dominant behaviour. However, a deviation did occur when the input device (keyboard and mouse) were separated from output (VDU). Whilst watching children play an interactive narrative game, it was observed that because the screen was located in a different place in the classroom, the children had to relay information from the screen to others on the keyboard. In this scenario, the children became part of the feedback loop from the visual display to the input device. The distributed location of the hardware created a gap in the activity and forced the participants to collaborate. It also appeared that because the pupils were highly motivated to complete the task, there was, in this instance, autonomous coordination in the group.

Unlike passive media, interactive narratives for learning must stimulate beyond an emotional engagement. It is important that there is a role for action, cognition and communication, to provide mechanisms that enable an enriched dialogue with others and artifacts. This should be reflected in interaction design that acknowledges engagement as mediated points of connection, rather than sources of information. In practice, this is about creating an *information gap*. Maintaining the collective narrative generates the information gap in sociodramatic play, and is bridged with language and action. Future design aims to capitalize on absence, by taking advantage of gaps in the narrative, interaction and feedback to encourage cognitive and social cooperation. Developing this requires interactive spaces that support multiple points of interaction, which can be used in parallel.

4.2. Perception and action in MR spaces

When testing the Audio Spaces prototype with multiple users, the participants repeatedly experienced difficulties making a cognitive connection between a physical action and the auditory response. Rather obviously this was caused by multiple participants moving at the same time, and was compounded by a lack of familiarity with the process. Consequently participants could not immediately connect their movement to the corresponding digital effect. There was more success with the transference of physical action to digital environment using the chromakey. The children's action would correspond to their placement in the background video content. For example, during an activity where the children were located in a pan of Mars, the children situated themselves to the edge of the planet, with their arms out-stretched – as if flying.

Inhabitants of MR spaces seemly switch their perception between these spaces, either drawing the data together to create a cohesive model or existing with multiple presences [6]. The design practice considers how to encourage foviation between these 'realities' as a way of collaboratively interweaving them with illusionary space. Switching between the play world and the 'real' world is an important social component of play. Observations of sociodramatic play showed that children constantly alternate between defining their character - *"I'm a cat and you're my mum*", *"Look, I'm on TV"* - to enacting the character's behaviour (i.e. meowing and crawling on all fours). 'Their language and action are both the process and product of their fantasy play' [17]. In allowing the children to communicate the connections between the 'realities', the collective imagination continues to be responsible for driving the play narrative, and the information gap remains.

5. Future Work

In October 2007, short term testing will be complete and the current application suite will be deployed in classrooms for the academic year. Long-term deployment will provide a platform on location for the development of the additional features raised in the summative findings. The continuing focus is on a more in depth analysis of the transference of action and reaction across the MR space, particularly as the participants become more familiar with the technology. Regular sessions will continue to be observed and recorded to analyse social and system engagement, and levels to which representational media and modalities of interaction integrate into play activities.

The project requires further investigation of suitable channels of communication for remote learners, to evaluate the qualities of telematic playmates. This is currently being trialed using iChat and a Joomla whiteboard to give a bi-directional A/V communication channel, and a shared workspace respectively. There are predicted to be particular issues that will arise from remote communication and collaboration. If in play, the shared illusion is maintained through action and language - for co-located users, distributed representational media can function as enrichment to immediate verbal and gestural dialogue among familiar playmates, but remote play presents particular problems. Relationships in the classroom are intimate and they have the advantage of sharing the same physical environment for reference. The children consequently share a large amount of common ground making communication more efficient, and therefore easier. However, if communication is wholly mediated, then much of the shared semantic and perceptual information is absent, and must be constructed through the given channels. Further, the influence of the affective state in play, suggests that there needs to be an emotional connection – it is not known at this stage whether this can be achieved enough to support a high enough level of familiarity between the players.

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