Ambient Sounds in the Woods *

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Abstract. In this paper we describe research in which we have used sound as part of a mobile multimedia learning experience for children. In this work we have classified sound clips into categories that appear to have differing effectiveness. We have also observed unexpected behaviour by the children indicating that our devices are capable of further development. We propose further research using sound to explore the contribution to learning of environment, content type and interaction mode.

1 Introduction

Handheld and wireless technologies have the potential to provide new ways for children to play and learn by allowing digital information to be combined with the physical environment. A multidisciplinary group of researchers have collaborated in the design of digitally augmented environments with the intention of addressing the question of how such augmentation supports learning about, and interaction with, the environment [1]. A number of innovative play and learning environments have thus been developed to explore ways in which ubiquitous technologies can support effective, imaginative and engaging interaction for children. These scenarios range from indoor settings [2], to field trips into the woodlands of Sussex. They involved both audio and visual media used in innovative ways, each presenting particular challenges and design opportunities. In this paper we first describe our experiences in the Ambient Wood, then discuss some of the issues relating to mobile sound in the playing and learning context, and finally propose ways in which these may be studied in greater depth.

2 The Ambient Wood

The Ambient Wood was a digitally augmented learning experience designed to support 11-12 year old children learning about habitat distributions and interdependencies. The experience was designed to encourage children to engage in scientific enquiry by providing them with novel ways of integrating different kinds of knowledge through digital and physical experiences. Pairs of children,

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equipped with a number of devices, collaboratively explored different woodland areas supported by a local and a remote facilitator. The experience was designed to stimulate inquiry by creating events that are unexpected causing the children to pay attention, wonder why and question outcomes [3]. It was also designed to draw the children's attention to important factors and processes of the environment that they would not normally discover through exploring the physical world with naked ear and eye, for example, by revealing invisible plant processes such as photosynthesis.

The physical environment was prepared with RF location beacons and a WiFi network. A variety of audio devices and multi-modal displays were used to present the added digital information, sometimes triggered by the children's exploratory movements, and at other times determined by their intentional actions. A field trip with a difference was thus created where children discover, hypothesize about, and experiment with biological processes taking place within the physical environment.

3 Sound Design

In our initial design of the Ambient Wood learning experience a number of location based sounds were broadcast to the children. Whenever they moved to particular positions in the woodland, where an RF location beacon, or 'pinger', was hidden, their physical presence triggered a sound that was played through nearby wireless loudspeakers, also hidden. This design was aimed at giving a richer experiential texture to the learning experience where digital sounds of woodland organisms were added to the natural environment. These included: animal sounds (e.g. bird singing, caterpillar eating) and plant sounds (e.g. thistle dying, leaves decomposing). One goal of using this technique was to provide an element of surprise. If the children walked past a hidden beacon, a particular sound would be triggered, but the children would be unaware when this might happen and what caused it. This technique was intended to stop the children in their tracks to figure out what the sound signified, and why it had happened.

Moreover, we wanted the sound to draw the children's attention to aspects of the habitat they might not otherwise notice, providing relevant contextual information that they could integrate with their experience. For example, if the children walked past a certain bush that attracted butterflies, a sound representing a butterfly drinking nectar would be played. The aim was for children to reflect upon this unusual sound and work out the interdependency between the flowering of the bush and the butterflies feeding upon it. However, our findings from the first Ambient Wood trials showed that the ambient sounds provided in this manner appeared to 'fit' into the setting so well that they were hardly ever noticed by the children. Even when a facilitator drew their attention to the sounds after they had been played, the children would look somewhat puzzled, having not registered them. This raised the question of whether our original design of ambient sounds was in fact *too* ambient so that they were simply not heard amongst the 'noise' of the other naturally occurring sounds in the wood.

Fig. 1. Listening to the Horn.

4 The Ambient Horn

To overcome the noise problem of the children missing the pervasively delivered sounds we decided in a subsequent design of Ambient Wood to give the children control over the playing of the sounds, where they have to physically interact with a handheld device in order to listen to them. The Ambient Horn is a purpose built remotely triggered audio player with a small horn loudspeaker attachment [4]. It uses sounds to provide children with access to information cues about hidden or invisible processes not normally available to the naked eye or ear, see Figure 1. The Horn was designed to still maintain the effect of surprise by the apparent serendipitous triggering of digital information (still using location pingers), but also enabling the children to choose exactly when to play the sounds. A simple interface was designed, using indicator lights to alert the children to the presence of a sound, and a press switch to enable them to play the sound. Thus the sounds were still accessible in a contextually relevant part of the wood, but the Horn enabled the sounds to be kept 'on hold' until the children themselves were ready to listen to them. This way, the children could remain engrossed in their ongoing activities until one of them noticed that a sound had been triggered and was ready to be played.

A variety of symbolic and abstract sounds were used to represent various plant and animal processes, such as, photosynthesis and animals feeding. Again our aim was to design a set of sounds to be played with the Ambient Horn that could facilitate children's reflection and discussion as to their meaning and significance. Abstract animations have been found to promote reflection, creativity and imagination in children, likewise, we supposed that abstract sounds could provoke reflection, by requiring the children to interpret the sounds based on what they know and what they see around them. To this end, we chose a variety of sounds to represent a range of ecological processes that take place in the woodland. As well as actual recordings of natural sounds, or direct sounds, e.g. birdsong, we used two kinds of mappings, arbitrary and symbolic. An example of

Fig. 2. Searching for Sounds.

an arbitrary mapping was the use of a fizzing sound to represent photosynthesis. Here, our aim was to provoke children into understanding the factors involved in photosynthesis, identifying the different aspects that were visible to them in the woodland. An example of a symbolic mapping was the use of a chomping sound to represent animal eating behaviour.

5 Findings

Twelve pairs of children used the Ambient Horn. Overall, the Horn proved to be successful for augmenting learning, acting as a tool to promote reflection, interpretation and further exploratory activity in the woodland. The children found it easy to use, requiring little explanation or training. They found it to be engaging, and showed great interest and eagerness to listen to sounds. Several children expressed enjoyment, e.g. pointing out to the other one "listen to that!".

We found that different representational levels of sound influenced the level of reflection and understanding of content. Arbitrary sound mappings seemed to generate more verbal discussion between pairs of children and the generation of ideas for contemplation than did the direct mappings. However, direct and symbolic mappings provided easy access to relevant information not normally available directly from the physical environment, providing a level of cognitive offloading. For example, the presence of animals such as birds/ rabbits and the processes relevant for supporting their existence in the environment.

The children intuitively interacted with the Horn itself in a variety of ways. Some pairs of children held it to their ear to listen to the sound as might be expected. In these instances they took it in turn to listen to the sound, with sometimes one child holding it for the other child to hear. Other pairs chose not to hold the Horn to their ear, but held it in front of them, enabling both children to listen at the same time. The design allowed children to collaboratively engage with the device and encouraged good sharing practice.

Although the Horn was designed to play sounds triggered by pingers, many of the children used it in unanticipated ways to interact with their environment. Some perceived it as an instrument that could collect sounds, see Figure 2. Their actions suggest that they appropriated the tool as a collecting device, choosing what kinds of things to hear, for example, taking it to different plants, thus, naturally associating a sound with an item or object. Several children also made scooping actions with it through the air, as if to catch a sound, exploring different places where they might get sounds. This indicated that the Horn device could also promote other forms of interaction with the environment by offering different modes of information delivery and access which may influence explorative activity and the degree to which learners make links and integrate information.

6 Further Studies

New ways of working with digital media afforded by pervasive computing devices offer augmented learning experiences and different ways for learners to interact with their environment. We identify environment, content type and interaction mode as significant aspects of the learning experience which warrant further research.

We have presupposed that presentation of content in its natural context, or environment, is complementary to the interpretation of information. The ways in which the learner is affected by the environment can be explored further. Is it important to identify where to play which sound, when to play the sound and for how long? We plan to study the relationship of context to sound interpretation, to better inform about most appropriate timing and location of the sounds. For example, do children always relate sound to context or not? When do they and when dont they? This will also enable us to examine in more detail at whether the different permutations draw and focus learners attention; support learners in using the sounds to make links between the sound, environment and task; and affect reflection at different levels of abstraction.

The Ambient Wood used the different types of sound to digitally augment the environment (direct, symbolic, arbitrary). These represented organisms and processes in the wood to support learning about, and interaction with, the environment. However the broad scope of our trials prevented us from distinguishing in depth between the relative merits of these classes and how these affect the learning and deeper understanding taking place within the context of ecology. Our aim is to find out what sounds are appropriate for use depending on functionality and content. We propose further studies to look more specifically at sounds and mappings by exploring what kind of sounds and mappings trigger reflection at what level; and what kinds of meanings children take from different kinds of mappings.

The children's use of the Ambient Horn to try to collect sounds intrigued us. The Ambient Wood employed different techniques, or interaction modes, for children to access or receive information and this encouraged them to experiment in unexpected ways. One technique was by providing the children with

devices that could probe the environment, such as an environmental probe tool with which information access was initiated by the children, and therefore under their control. The other technique was by pinging information according to the children's location and was less under the direct control of the children. By supporting different modes of delivery and access we intend to seek how the type of information flow supports learning, reflection and understanding. Initial findings from Ambient Wood suggest that these different modes may influence the level of reflection; the making of links and integrating information; and explorative activity. This study will focus on exploring the potential differences in learning and understanding that occur according to mode of delivery.

7 Conclusion

We thus propose further field trials in which children are required to identify organisms in the environment, and to build up a picture of relationships between these organisms and the processes that enable them to survive, using what they hear on a handheld audio device. To do this the children will be asked to construct food chains using sounds as clues. Exact wording of such tasks will be made in collaboration with a teacher to ensure appropriate language level for the targeted age group. Again we would place pingers in the environment to trigger sounds according to location and explore different permutations of type of sound with specified locations, and different permutations of timings of sound. In addition we intend to augment the Horn design with gesture recognition to facilitate probing for sounds. We will be seeking evidence of eliciting verbal reflection by noting the children's awareness, attention focus and reflection, and how these are related to environment, the type of sound, and delivery and access.

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