Interacting with Technology

Lecture 3: Mobile and tangible technologies for children

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Overview

Introduction & Lecture 1: Children, schools and technology

Lecture 2: Mobile technologies and sensors

Lecture 3: Mobile and tangible technologies for children (NB Presentation groups)

Lecture 4: Case study: Children and technology

Lecture 5. Exploring spatial cognition with novel technologies

Lecture 6: Aiding spatial cognition in children

Lecture 7: Evaluating 'in the wild'

The Ambient Wood Project

- small groups of children using mobile technologies outdoors to support scientific enquiry about the biological processes taking place in a wood.
- One of the devices used, a probe tool, contained sensors enabling measurement of the light and moisture levels within the wood. A small screen was also provided which displayed the readings using appropriate visualisations.

Handhelds to make the invisible visible

- Measurements of light and moisture at different locations were displayed on a PDA in pictorial format.
- Mobile devices used to receive location-specific information.

Video

Key findings

Analysis of the patterns of interaction revealed:

- The probe engendered exploration, the generation of ideas (about where to probe in order to get different readings, or to see readings around particular plants).
- Children made links between their readings, for example, comparing readings taken by the same species of plant, but in different locations.
- Children made predictions about readings they might expect in particular locations, for example, one pair predicted a moist reading because there was lots of moss.
- Many also drew conclusions about the general physical state of the woodland, and how this related to the environment and the organisms found on the basis of their probe readings.

New Technologies: Tangibles

- Technologies which are new (& therefore often unstable) are hard to explore experimentally *in situ*
  - (likely to) generate interesting behaviour and therefore worth studying, but:
    - On hand technical support is necessary
    - Not used in everyday classroom (or other cultural) practice
  - Therefore more abstracted in-lab studies may be more appropriate

From GUIs to TUIs

GUI – Graphical User Interface

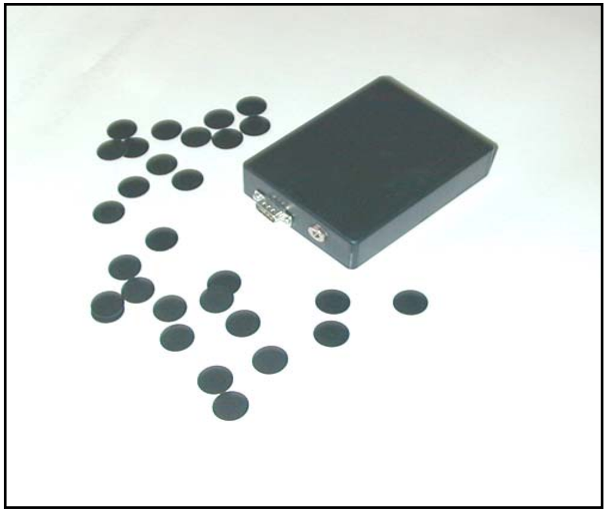
TUI – Tangible User Interface

- Digital spaces traditionally manipulated with simple input devices (keyboard and mouse), which are used to control and manipulate (usually visual) representations displayed on output devices such as monitors, whiteboards or head mounted displays.
- What has become known as ‘tangible interfaces’ attempt to remove this input-output distinction and try to open up new possibilities for interaction that blend the physical and digital worlds (Ullmer & Ishii, 2000).
- Tangible interfaces emphasise touch and physicality in both input and output.

What are Tangible Interfaces?

Some tangible interfaces consist of relatively simple and cheap technologies (e.g., barcodes, sensors).

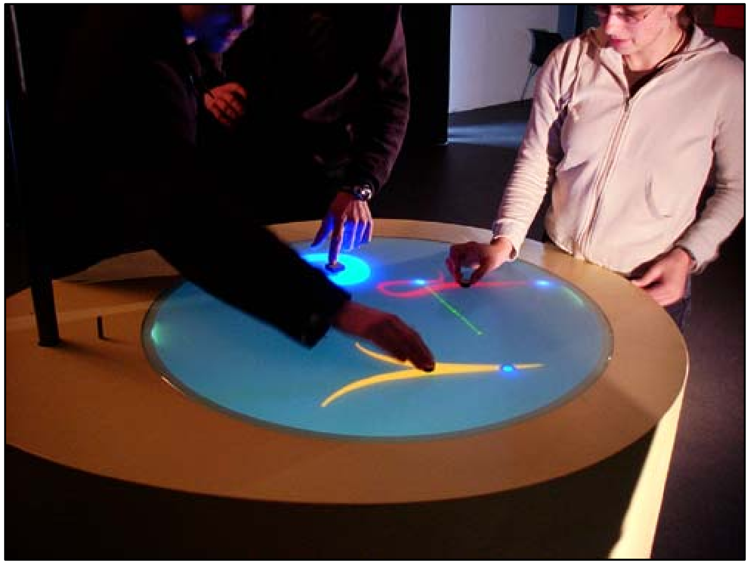
Other tangible interfaces are still in the early stages of development and involve more sophisticated uses of video-based image analysis or robotics.

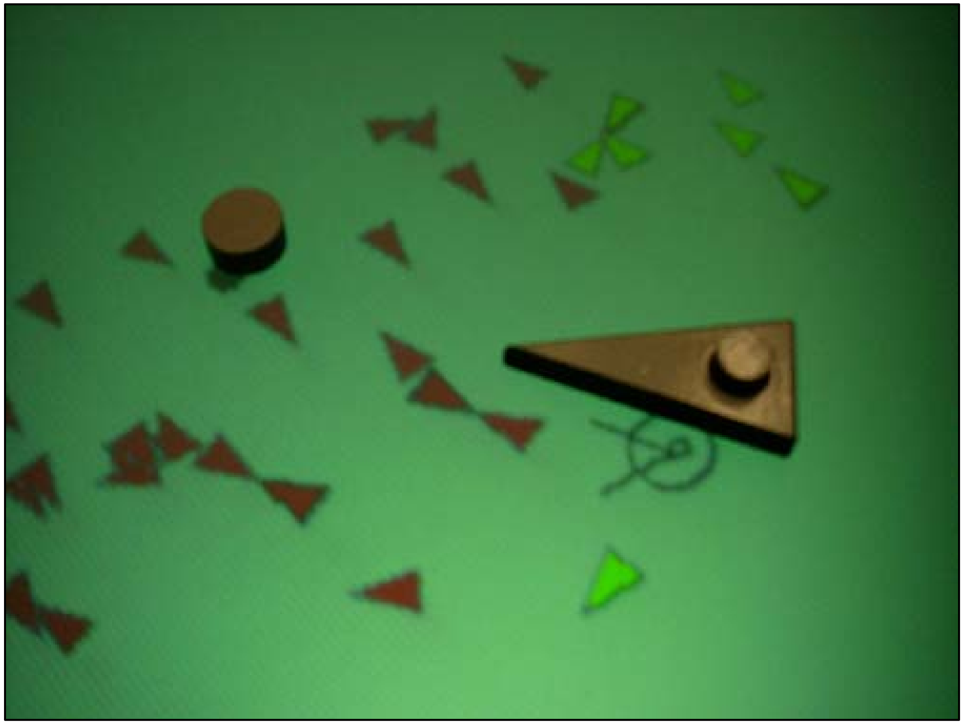


What are Tangible Interfaces?

http://www.media.mit.edu/groups/gn/projects/animalblocks/
http://www.sics.se/kidstory/
http://www.ioe.stir.ac.uk/CACHET/
http://web.media.mit.edu/~kimiko/projects.htm

Tangible interfaces





Potential of Tangible Interfaces

- Tangible technologies are part of a wider body of developing technology known as ‘ubiquitous computing’ in which computing technology is so embedded in the world that it ‘disappears’.

- Tangible interfaces may be of significant benefit to education by enabling, in particular, younger children to play with actual physical objects augmented with computing power.

- Research from psychology and education suggests that there can be real benefits for learning from tangible interfaces. Such technologies bring physical activity and active manipulation of objects to the forefront of learning.

Why may tangibles aid learning?

- Historically children have played individually and collaboratively with physical items (building blocks, jigsaws..) and have been encouraged to play with physical objects to learn a variety of skills.
- Montessori believed that playing with physical objects enabled children to engage in self-directed, purposeful activity. She advocated children’s play with physical manipulatives as tools for development
- Resnick extended the tangible interface concept for the educational domain in the term ‘Digital Manipulatives’ (Resnick et al., 1998). These are familiar physical items with computational power aimed at enhancing children’s learning.

Why may tangibles aid learning?

- Familiar objects (building bricks, balls) are physically manipulated to make changes in an associated digital world, capitalizing on people's familiarity with their way of interacting in the physical world (Ishii & Ullmer, 1997).

- In relation to learning, such tangibles are thought to provide different kinds of opportunities for reasoning about the world through discovery and participation

- Tangible-mediated learning also has the potential to allow children to combine and recombine the known and familiar in new and unfamiliar ways encouraging creativity and reflection (Price et al., 2003).

Physical Manipulatives for Learning

- physical action is important in learning – children can demonstrate knowledge in their physical actions (e.g., gesture) even though they cannot talk about that knowledge
- concrete objects are important in learning – e.g., children can often solve problems when given concrete materials to work with even though they cannot solve them symbolically or even when they cannot solve them ‘in their heads’
- physical materials give rise to mental images which can then guide and constrain future problem solving in the absence of the physical materials
- learners can abstract symbolic relations from a variety of concrete instances
- physical objects that are familiar are more easily understood by children than more symbolic entities

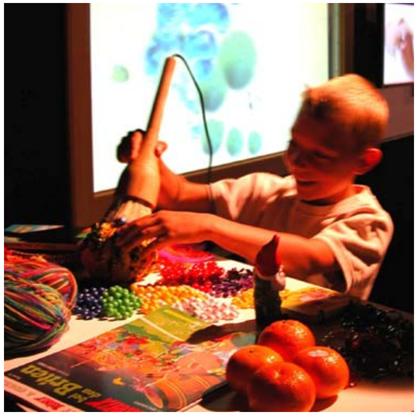
Tangible Interfaces and Digital Manipulatives

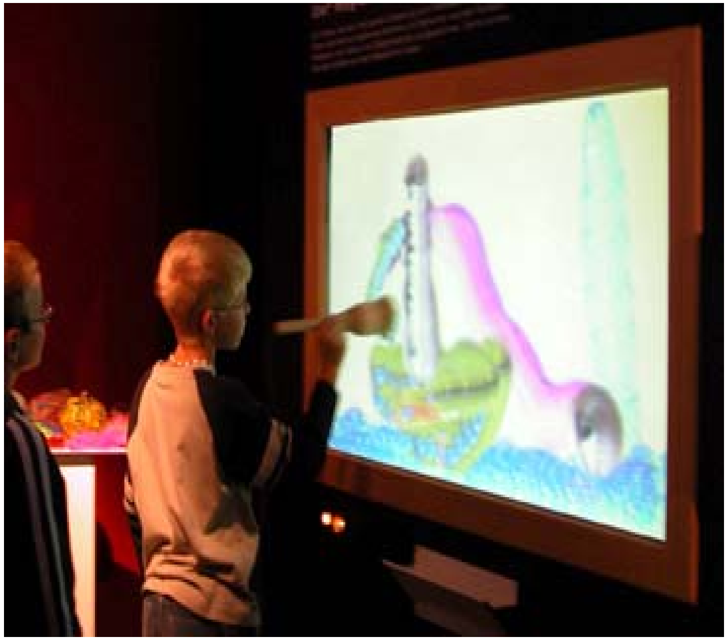
- allow for parallel input (e.g., two hands) improving the expressiveness or the communication capacity with the computer
- take advantage of well developed motor skills for physical object manipulations and spatial reasoning
- externalise traditionally internal computer representations
- afford multi-person, collaborative use
- physical representations embody a greater variety of mechanisms for interactive control
- physical representations are perceptually coupled to actively mediated digital representations
- the physical state of the tangible embodies key aspects of the digital state of the system

Case studies with tangibles

Imagine a reception class is creating a story together. Their teacher has been reading from a storybook about Peter Rabbit during literacy hour over the past few weeks. Today they are trying to create an animated version of the story to show in assembly. They are using special paintbrushes which they can sweep over the picture of Peter Rabbit in the storybook. One child wants to draw a picture of Peter Rabbit hopping. He places the brush over the picture of Peter Rabbit and as he does so he makes little hopping motions with his hand. Then he paints the brush over the display screen that the class are working with and as he does a picture of the rabbit appears, hopping with the same movements that the child made when he painted over the storybook. The special paintbrush has 'picked up' the image, with its colours, together with the movements made by the child and transferred these physical attributes to a digital animation.

I/O Brush





These images show the 'I/O Brush' system developed by Kimiko Ryokai, Stefan Marti and Hiroshi Ishii of MIT Media Lab's Tangible Media Group[1] (Ryokai, K., Marti, & Ishii, 2004).

[1] http://web.media.mit.edu/~kimiko/iobrush/

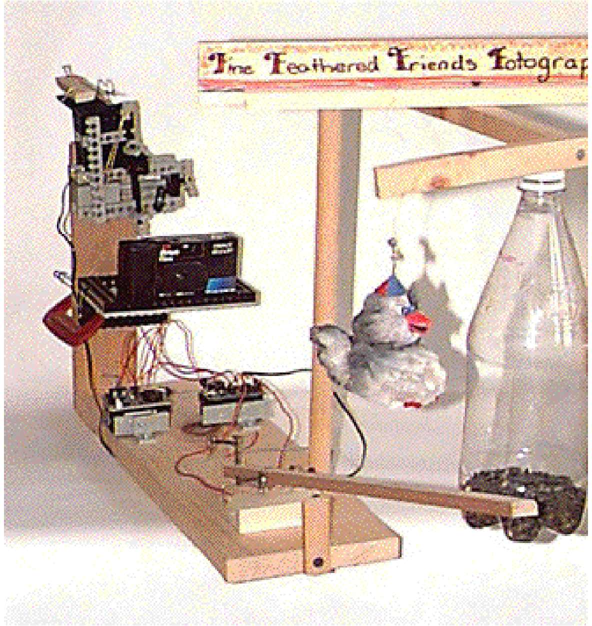
CACHET

- In recent years a range of digital toys have been designed aimed at very young children.
- One example is the suite of Microsoft ActiMates™, starting in 1997 with Barney™ the purple dinosaur.
- The CACHET project (Luckin, Connolly, Plowman, & Airey, 2003) explored the use of these types of interactive toys (in this case, DW™ and Arthur™) in supporting collaboration.
- The toys are aimed at 4-7 year olds and contain embedded sensors that are activated by children manipulating parts of the toy.
- The toys can also be linked to a PC and interact with game software to give help within the game.

- Luckin et al compared the use of the software with help on screen versus help from the tangible interface and found that the presence of the toy increased the children's interactions with one another and with the facilitator.

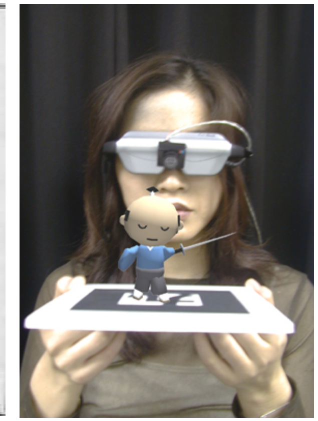
P-Bricks

- Children as young as 10 years old used programmable bricks and crickets to build and program robots to exhibit chosen behaviours.
- Crickets have been used by children to create their own scientific instruments to carry out investigations (Resnick, Berg, & Eisenberg, 2000).
- For example, one girl built a bird feeder with a sensor attached so that when the bird landed to feed, the sensor triggered a photo of the bird to be taken. The girl could then see all the birds that had visited the feeder while she was away.



BBC Jam AR story software

- An evaluation of the BBC Jam AR story software in school classrooms and homes with learners ranging from 3 to 7 years of age



BBC Jam

- A variety of data sources to explore the potential offered by this technology: Data sources include:
  - Email survey sent to all those who registered to use the AR software. 71 responses received (parents, teachers and ICT co-ordinators)
  - Telephone interviews conducted with 14 users who expressed willingness to take part further when they responded to the email survey.
  - Observations (video tapes and researcher notes) and interviews with ten schools and seven homes from a wide range of backgrounds in Bath, Sussex and London. Teachers and parents were also invited to report on sessions in-between observation sessions using diaries.
  - Video tapes and researcher notes from a pilot study involving 12 children comparing the use of the *Looking for the sun* story in the form of the AR storybook, the Flash software and a pop-up book. Data sources from this study also include post session interviews plus children’s drawings.

Conclusions

- Tangible technologies are becoming interesting for classroom settings
- Technologies are bespoke and untested for learning gains while there are many hypotheses about their potential
- Isolating these hypotheses to test them independently of the technical implementation and classroom situation is a complex and ongoing process

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