Controversies in Cognition

Influences of New Technology on Psychology Research in Educational Settings (2)

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Reminder Content

- Education
  - Working with schools versus testing in schools
- Traditional technologies
- New technologies:
  - The Shared Desktop
  - Sensors and Context
  - **Mobile and Wireless**
  - **Tangibles**

New Technologies: Mobile and Wireless

Outside the school: the fieldtrip

Example: 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 visualisations.

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 so new (& therefore 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

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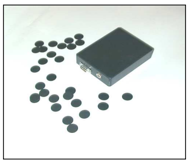
What are Tangible Interfaces?

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.



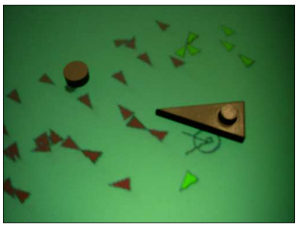
Controversies 2005

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

Controversies 2005

Tangible interfaces



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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.

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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.

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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

A case study with tangibles

References (1)

Abnett, C., Stanton, D., Neale, H and O'Malley (2001) The effect of multiple input devices on collaboration and gender issues. In the *Proceedings of European Perspectives on Computer-Supported Collaborative Learning* (EuroCSCL) 2001, March 22-24, Maastricht, the Netherlands. P.29-36.

Druin, A., Stewart, J., Proft, D., Bederson, B., Hollan, J. (1997). *KidPad: A design collaboration between children, technologists, and educators.* Proceedings of CHI'97, Atlanta, GA.

Druin, A. (2002). The Role of Children in the Design of New Technology. *Behaviour and Information Technology*, 21(1) 1-25.

Inkpen, K., Booth, K.S., Klawe, M., and Upitis, R. (1995). Playing Together Beats Playing Apart, Especially for Girls. *Proceedings of Computer Supported Collaborative Learning (CSCL) '95*. Lawrence Erlbaum Associates, 177-181.

Inkpen, K. M., Booth, K. S., Klawe, M., & McGrenere, J. (1997). The Effect of Turn-Taking Protocols on Children's Learning in Mouse-Driven Collaborative Environments. *In Proceedings of Graphics Interface (GI 97)* Canadian Information Processing Society, pp. 138-145.

Inkpen, K.M., Ho-Ching, W., Kuederle, O., Scott, S.D. & Shoemaker, G.B.D. (1999) 'This is fun! We're all best friends and we're all playing': Supporting children's synchronous collaboration. In *Proceedings of Computer Supported Collaborative Learning (CSCL99)* (eds. C.M. Hoadley & J. Roschelle) pp. 252–259. Lawrence Erlbaum, Hillsdale, NJ.

Ishii, H., & Ullmer, B. (1997). Tangible bits: Towards seamless interfaces between people, bits and atoms. *Proceedings of the ACM SIGCHI conference on Human Factors in Computing Systems (CHI'97)*, 234-241

References (2)

Littleton, K. (1999). Productivity through interaction: An overview. In K. Littleton and P. Light (Eds.) *Learning with Computers: Analysing productive interaction*. Routledge. London p.179-194.

O'Malley, C and Stanton Fraser, D. (2004). Literature Review in Learning with Tangible Technologies. *NESTA. Nesta Futurelab series*, report 12.

Price, S., Rogers, Y., Stanton, D. and Smith, H. (2003). A new conceptual framework for CSCL: Supporting diverse forms of reflection through multiple interactions. *In Proceedings of Computer Support for Collaborative Learning. (CSCL) 2003*, Kluwer, pp. 513-523.

Resnick, M., Maryin, F., Berg, R., Boovoy, R., Colella, V., Kramer, K., et al. (1998). Digital manipulatives: new toys to think with. *Proceedings of the ACM SIGCHI conference on Human factors in computing systems*, 281-287.

Rogers, Y, Price, S., Randell, C, Stanton Fraser, D., Weal M. and Fitzpatrick, G. (2005). Ubi-learning: Integrating Indoor and Outdoor Learning Experiences. *Communications of the ACM*. January 2005/Vol. 48, No. 1

Rogoff, B., *Apprenticeship in Thinking: Cognitive Development in Social Context*. New York: Oxford University Press, 1990.

Stanton, D., Neale, H. and Bayon, V. (2002) Interfaces to support children's co-present collaboration: multiple mice and tangible technologies. *Computer Support for Collaborative Learning. (CSCL) 2002*. ACM Press. Boulder, Colorado, USA. January 7th-11th.p.342-352

References (3)

Stanton, D. and Neale, H. (2003). Collaborative Behaviour around a computer: the effect of multiple mice on children's talk and interaction. *Journal of Computer Assisted Learning (JCAL),* Blackwell, Vol. 19, no. 2, pp. 229-239.

Stanton, D., O'Malley, C., Bayon, V., Hourcade, J-P., Sundblad, Y., Fast, C., Cobb, S., Taxen, G and Benford, S. (2004). The KidStory Project: Developing collaborative storytelling tools for children, with children. *Developing New Technologies for Young Children.* Edited by John Siraj-Blatchford. Trentham Books Ltd, UK.

Stanton Fraser, D., Smith, H., Tallyn, E., Kirk, D., Benford, S., Rowland, D., Paxton, M., Price S and Fitzpatrick G. (In press). The SENSE project: a context-inclusive approach to studying environmental science within and across schools. *Computer Supported Collaborative Learning (CSCL 2005).* Taiwan. May.

Tallyn, E., Stanton, D., Benford, S., Rowland, D., Kirk, D., Paxton, M., et al. (2004). Introducing eScience to the classroom. *Proceedings of the UK e-Science All Hands Meeting,* EPSRC, pp. 1027-1029.

Wood, D., & O'Malley, C., Collaborative learning between peers: An overview. *Educational Psychology in Practice,* 11(4), 4-9, 1996