Next Generation of HCI and Education: Workshop on UI Technologies and Educational Pedagogy

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Abstract
Given the exponential growth of interactive whiteboards in classrooms around the world, and the recent emergence of multi-touch tables, tangible computing devices and mobile devices, there has been a need to explore how next generation HCI will impact education in the future. Educators are depending on the interaction communities to deliver technologies that will improve/adapt learning to an ever-changing world. In addition to novel UI concepts, the HCI community needs to examine how these concepts can be matched to contemporary paradigms in Educational pedagogy. The classroom is a challenging environment for evaluation, thus new interaction techniques need to be established to prove the value of new HCI interactions in the educational space. This workshop provides a forum to discuss key HCI issues facing next generation education ranging from whole class interactive whiteboards, small group interactive multi-touch tables, and individual personal response systems in the classroom.

Keywords
Next generation HCI, Education, pedagogy, multi-touch, gestures, large displays

ACM Classification Keywords
H5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous.

General Terms
Design, Human Factors

Introduction & Motivation

Interactive whiteboards have experienced exponential growth across many countries in recent years. This has resulted in a growing acceptance of digital content for delivering lessons in the classroom. Interactive whiteboards have also been quite successful in education given the proliferation of lesson relevant content easily accessed through the Internet.

Building on the discussions of the CHI workshop on the Next Generation of HCI [Jacob et al., 2007] there is a growing need to research how this technology (multi-touch tables such as those in Figure 1 (left), tangible computing devices and mobile devices) will be leveraged in educational environments. As this next generation of HCI technology arrives in the classroom, educators are expecting researchers and practitioners to determine how this technology will align with contemporary educational pedagogy.

New technologies such as multi-touch whiteboards (see Figure 1, right) and interactive tables can be used by teachers to aid communication and collaboration. Gestures serve as consequential communication [Gutwin, et al., 1998] so a teacher scaling a calendar with two fingers is indicating that it is important. Instruction is very much linked to speech actions in real time, and modern speech processing is opening up a number of exciting opportunities.

Technology can assist and hinder educational pedagogy. In this workshop we take the approach that next generation HCI technologies will have a significant role in learning if the technology is applied in a pedagogically appropriate way and rigorously evaluated in the field.

Below we begin the discussion with perspectives of educational pedagogy, cognitive and physical design challenges, multi-user content development, and a revisitation of evaluation in an educational setting.

Educational Pedagogy

The paradigm shift from teacher-centric to learner-centric pedagogy [Astin, 1984, Johnson et al., 1998, Freire, 1970] is being mirrored by teaching technologies that support the activities of a single teacher to those that support individual learners and small group activities.

Student-teacher and student-student negotiation is a key aspect of self reflection [Vygotsky, 1978]. Digital technologies have the potential to support self reflection by enforcing agreement for global actions and encouraging negotiation when learners do not agree.

A recent study reported by Piper et al [Piper 2009] on the effect of a multi-touch table in a small group collaborative learning setting for a neuroscience class at UCSD demonstrated that the multi-touch table encourages students to experiment more with problem solutions. Computer systems are ideal for providing real-time feedback and validation to learners in a collaborative environment. This feedback can provide a sense of personal significance that is a part of constructivist learning [Rendon, 1994, Bruner, 1996].

Figure 1: Samples of Next generation HCI technologies being applied to Educational Pedagogy. The GeoLens application (left), SMARTs multi-touch table (middle) and an interactive multi-touch whiteboard (right). (middle, right) SMART Technologies ULC. All rights reserved.

Educational pedagogy has long since recognized the value of active involvement in learning [Montessori, 1912, Astin, 1984]. Technologies that respond to these actions such as mixed reality, direct manipulation, and multi-touch interfaces are only beginning to be applied to schools, and much of their potential to advance educational pedagogy requires further exploration by the research community.

Design Challenges

When developing interfaces for children in the educational domain many design challenges arise.

- Design for children
- Delivering multiuser content
- Evaluation in an educational setting (metrics, methods, and logistics)

Design for Children

It is well know that children's cognitive and social skills develop over time [Piaget, 1972, Bruckman et al., 2003], next generation HCI techniques will need to consider both the physical and cognitive challenges that face young learners.

New HCI techniques will need to revisit the developmental cognitive skills of children especially in the 4 to 12 year age ranges. Cognitive skills such as memory load must be appropriate for the age level. Similarly, response time varies with younger age groups thus appropriate interaction times are important. Active involvement with the learning material is best achieved when the user interface is intuitive and unobtrusive, ensuring that children's concentration is maintained throughout the activity. Developing literacy skills also need to be considered in interface design where icons are used instead of text.

Physical motor skills are a design factor when next generation HCI devices are to be used by children. For example, fine motor skills are not fully developed yet in younger children thus precise object positioning can be a challenge. Interface designers need to consider appropriate target selection mechanisms, employing large widgets, and easy to perform drag and drop operations.

Delivering multiuser content

Instructors generally have limited time to perform lesson creation in classrooms. Some produce content after classes are finished or at home, but the amount of

effort they will be able to spend is limited. This problem is exacerbated in the multi user scenario, in a divide and conquer scenario a lesson than took a teacher eight minutes to build could be completed by 4 students working together in two minutes. HCI design must consider the needs of instructors to create lesson-relevant content as quickly and easily as possible.

Evaluation in an education setting

Next generation HCI devices have significant potential to capture real time actions of participants and use this data for evaluation. There is a need to recognize the diverse types of learning environments (whole classroom, small groups, field trips, and informal learning) and determine metrics suitable for comparison. HCI work will need to synergize with efforts from the learning science and pedagogical communities to establish meaningful evaluation metrics for these new technologies and user interfaces.

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