It CAN be a Small World After All: Physical and Digital Media Connect to Support Cross-Cultural Exposure

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Abstract: Young children are accustomed to learning through play and interaction with physical objects. Our tool builds on that natural learning process by transparently linking artifacts to digital material. Radio Frequency Identification (RFID) technology can be used to tag these items so that children can activate multimedia learning modules automatically. We will demonstrate the LAMBERT (Language Acquisition Manipulatives Blending Early-childhood Research and Technology) system which includes RFID readers (both mobile and stationary), tangible toys with RFID tags attached, and software developed in-house that launches the media presentations. The purpose of the digital content is language acquisition (ex. American Sign Language, Spanish, etc.) and concept expansion (i.e. various types of cows or apples). We will also show video of children successfully using the system during a pilot study. Development plans that are underway will be outlined including the use of solar-powered devices that may allow students, specifically Deaf children, in developing countries access to learning opportunities not usually available.

Keywords: Computer Assisted Instruction, Developing countries, Learning Systems, Multimedia, Special Needs, Innovation, Learner-Centered Learning, Primary Education, Deaf, RFID
1. Literature Review Highlights

Several terms such as ‘tangible interfacing’ and ‘physical browsing’ have been coined to address the concept, dating back to 1993, of creating a direct link between computer-based activities and real-world objects and events (Price, 2008; Valkkynen, Niemela, & Tuomisto, 2006). Although the field is still in its infancy, especially in regards to special needs populations, there has been increased momentum behind related research projects as evidenced in part by the creation of the International Conference on Tangible and Embedded Interaction (TEI) in 2007. In fact, Girouard, Solovey, Hirshfield, Ecott, Shaer, Jacob assert, “Tangible computing combines the best of the digital and physical worlds: real time feedback for each student and physical manipulatives to promote abstract learning” (2007, p. 183). Price (2008) echoes that sentiment adding that learning and cognition theories offer compelling rationales for investigating tangible interaction. Prior to Piaget’s formal operational stage (i.e. age 11 approximately), children need concrete, hands-on, experiences rather than abstract concepts to support more natural learning, developing and thinking (Marshall, 2007).

“Conventional computers do not support concurrent interaction and physical exploration experience which is most familiar to preschool children,” (Sung et al, 2007 Related Works). Very young children learn by exploring their surroundings, mostly by playing during which they construct mental representations of the world (Hengeveld, Voort, Balkom, Hummels, & Moor, 2007). It thus appears that tangible interaction research is a viable strategy to explore especially with young children for learning in the digital age. A technique that has shown potential in bridging that connection between concrete environments and virtual artifacts is radio frequency identification (RFID).

One of the first wide-spread uses of RFID technologies in the field of education was for enhanced museum experiences whereby students used handheld devices to scan exhibit signs that were linked to supplemental, digital information (Papadimitriou, Komis, Tselios, & Avouris, 2006). However, in terms of facilitating interaction between tangible objects appropriate to early childhood and digital data, RFID is just gaining momentum. A previous review of the literature uncovered only a handful of such systems. Of those, the one most closely aligned to this project’s premise is the ‘Shadow Box’ which consists of blocks of wood with embedded RFID tags, a computer, and a stationary reader (Sung et al, 2007). The wood blocks are divided into shapes of items (i.e. a lion) and written word equivalents thereby allowing children (three and four year olds) to find matches, put them in the box, and receive immediate feedback about their pairing on a nearby monitor.
2. LAMBERT System Background

In response to this problem, the authors (Parton & Hancock, 2008) developed a prototype called LAMBERT (Language Acquisition Manipulatives Blending Early-childhood Research and Technology). The prototype was designed specifically for Deaf children from the United States who often need additional exposure to language since the majority of their parents are hearing and not fluent in American Sign Language (Erting & Pfau, 1997; Ardis, 2006). Physical toys representing twenty five nouns were purchased (i.e. apple) and tagged with a RFID chip. Corresponding 15 second videos were developed to teach/reiterate vocabulary through American Sign Language, printed English, and image associations. Each mini lesson contained an average of three photos, two clipart images, a video with a human signer, a video with an avatar signer, and a text slide that included spoken English for the benefit of hard-of-hearing children. See figure 1 for prototype image. Software was developed in-house to convert the completed media files into executables that would launch automatically based on the RFID tag that was scanned.

![Prototype of LAMBERT System](image)

Figure 1: Prototype of LAMBERT System

The prototype was setup at the Louisiana School for the Deaf in a preschool room and kids from multiple classes (ages three to five) rotated to the station to “play” with the toys. The children picked up the process very quickly. Their teacher showed them one time in a big group circle and after that the students selected objects from the table and touched the RFID reader with little to no assistance. They would also immediately look at the computer monitor to see the presentation and were noticeably excited as they watched. The children were engaged in the learning process and interacted with the manipulatives in a natural way so that the technology became a facilitator rather than a distracter.
3. LAMBERT Expansions

Based upon the success of the first prototype, the authors expanded the LAMBERT system in several ways over the course of the following year. First, Spanish printed text and audio was added to the multimedia presentation. The purpose was both to explore uses for ESL (English as a Second Language) students and to explore the benefits for Deaf children in the Dominican Republic. (Although most countries have their own sign language, the D.R. uses ASL along with written Spanish.) The LAMBERT system was shown to students at the Centro Cristiano de Educacion Para Sordos (Christian Center for the Deaf Education) and was well received. It is the authors’ intent to continue building additional languages into the system beginning with Mexican Sign Language. The rationale behind this decision is that Deaf children rarely get the opportunity to learn a foreign language the same as hearing children do.

Second, a mobile LAMBERT unit was developed. Up until this point, children had to take the manipulative (i.e. a toy representing a real world object) to a stationary computer. By using a PDA (personal digital assistant) equipped with an RFID reader plugged in through the SDIO slot of an HP Ipaq, the child had the freedom to go to a tag rather than bringing a tag to the computer. Thus real-world items, rather than representatives, could now be used for the physical/digital connection (i.e. a refrigerator can be tagged).

In the first prototype, the multimedia presentations were all static meaning the same show played whenever a tag was scanned. Therefore, a third development priority became the implementation of dynamic presentations based on student input. As a first step, the prototype was updated to accept two consecutive scans with one being a tangible noun toy and the second being a modifier card (i.e. an apple and then an adjective card such as red or green). The RFID reader recognizes when a noun versus a modifier card is scanned and in return launches both the static multimedia presentation for the object along with the dynamic content that demonstrates that adjective/verb.

Finally, teachers requested an assessment module for the prototype. In this mode, LAMBERT shows a multimedia presentation (a static one at this stage), and the child scans a toy in response. Feedback is given based upon the selected object. Currently, the entire multimedia show is used for the question, however it is the intent of the authors to segment out portion of the show (i.e. just the ASL/MSL, just the printed English/Spanish, etc.) for a future, more narrow assessment tool.

4. Concluding Comments

The LAMBERT system introduces a creative, relatively inexpensive way to integrate technology in schools so that the focus is on the learning not the hardware/software. The system can be easily expanded to incorporate new cultural
and linguistic data (i.e. the concept of ‘house’ in various countries is different but could be built into one presentation). In developing countries, the use of solar or manually-powered devices such as the XO laptop holds the possibility of access to new learning material. For Deaf students, the world can truly become more connected as they learn about other languages and customs.

References


