Grid Based Learning Environment: A Tangible User Interface for the Blind and Visually Impaired, Phase Two

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This 2nd year research presents a comparison between traditional classroom manipulatives, phase 1 (a set of single-valued radio frequency identification (RFID) magnetic cubes with solo reader), and a novel new set of multi-valued manipulatives with a custom RFID reading grid. This research focuses on creating an alternative method for the blind and visually impaired in K-12 to physically and digitally construct graphical representations encountered in STEM disciplines. Traditionally, classroom manipulatives require the knowledge of braille and are comprised of a large set of unique manipulatives. Utilizing traditional manipulatives involves interactions that are strictly hands-on; thus they require the instructor's dynamic involvement and approval at each step. Instructors are largely the solitary point of intervention and evaluation. The RFID reading grid was designed to assist the blind user to quickly and correctly complete a set of tasks (numbers, words, and mathematical expressions) by manipulating a set of trackable manipulatives, while engaging and reinforcing the reading of Braille. In contrast to traditional manipulatives, this new system can allow the user to work self-reliantly due to the audio-feedback via software which provides feedback to denote correct or incorrect interaction. In addition, the new design reduced the number of manipulatives which are simultaneously tracked as their position is changed via a set of readers located in the grid and can track natural interaction and manipulation. Results from a user study of 20 blind participants demonstrate significantly reduced overall workload, task completion times, and a higher accuracy rate when compared to the traditional classroom manipulatives when utilizing the new RFID Grid.

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