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Fostering shared intentionality for diverse learners through cross-sensory interaction design

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Summary

As the theme of this year's conference suggests, cognitive diversity among learners and educators is increasingly acknowledged. However, in our societies that increasingly require advanced education, training, and technical skills, the pressure to standardize learning objectives, delivery techniques and delivery tools, especially online, is high. In these situations, learners and educators of diverse cognitive phenotypes and abilities experience learning environments that are a poor match for their abilities, making effective delivery of educational content challenging. However, with such vast human variation, many learners and educators are experiencing benefits as well as challenges in online settings, accelerated by the COVID-19 pandemic. For example, working remotely provides neurodiverse individuals with greater control over their environments, in terms of noise, light, potential distractions and comfortable seating. (Das et al., 2021). In contrast, structured routines (e.g., commuting to class) that aid executive functioning are often lost (St. Amour, 2020). Neurodiverse learners may benefit from this new paradigm if their accessibility challenges can be met.

Evidence-based strategies that account for the now extensive (due to COVID-19's social distancing) lived experiences of those affected by these mismatches are still emerging. By moving forward with design that is informed by these accounts, researchers and developers position themselves to make observations while responding to real-world needs. In this way, our proposed workshop will aim to better understand lived experiences and challenges of workshop participants in their roles as learners or educators through co-design, a methodology in which participants actively engage in the design process.

Successful deployments of inclusive learning are thought to benefit all students (Alqurani and Gut, 2012). However, the needs of educators are rarely considered, nor do they often feel properly equipped with the knowledge, competencies, tools, or policies to foster these outcomes independently (Longfellow, 2021; Ware et al, 2021).

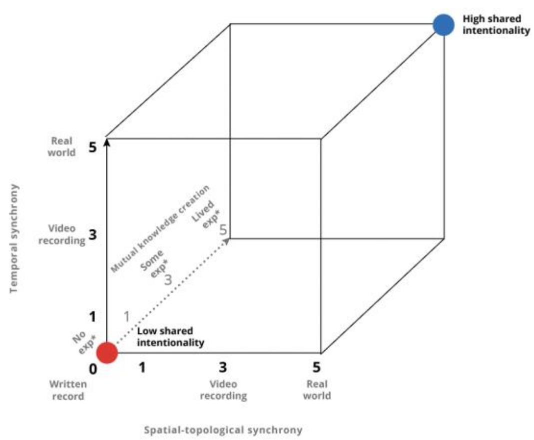

Figure 1: Model depicting conditions that foster high and low shared intentionality.

Cross-sensory interaction design entails two or more sensory modalities to redress these mismatches experienced by cognitively diverse as well as blind and partially sighted learners (Biggs et al., 2019; Ghodke et al., 2019; Kamat et al., 2022) by fostering *shared intentionality*, the capacity to participate in collaborative activities with shared goals and intentions (Tomasello et al., 2005). Our workshop will utilize a conceptual model (from Lee, Sukhai & Coppin, 2022) that applies this research on shared intentionality to digitally mediated interactions by recruiting Larkin and Simon's (1987) model for distinguishing diagrams versus sentences (the types of external representations graphical user interfaces are composed of). The model is composed of three dimensions. The first, by adapting Larkin and Simon (1987), is *spatial-topological synchrony* (Fig., 1, x-axis), which is the degree to which Information and Communication Technologies (ICTs) (e.g., Zoom) convey perceptual cues such as gesture, body location and visual-spatial representations. *Temporal synchrony* is the degree to which interactions are asynchronous or synchronous. *Mutual*

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knowledge creation is the degree to which new knowledge is jointly constructed from diverse perspectives (Lee et al., 2022). 0,0,0 (Fig. 1, red dot) denotes where shared intentionality is low, because cues for the success of shared goals are insufficient as visually represented spatial, topological, and geometric relations in the environment are not accessible, for example, to blind and partially sighted learners (cf. Coppin et al., 2016). 5,5,5 (Fig. 1, blue dot) denotes where shared intentionality is high when interactions in a physical space using a hand-over-hand technique is accessible to blind and partially sighted participants.

Thus, these models foreshadow the workshop's goal of co-designing and discussing strategies for inclusive learning environments. Specifically, the objectives of the workshop are: (1) to provide participants with shared language and tools to redress accessibility challenges engendered by how individual differences interacted with online learning environments during the pandemic; (2) to generate insights in response to diverse accessibility needs; and (3) to utilize insights from workshop participants' experiences to inform the next iteration of our tools[1] that more effectively foster shared intentionality through online learning. Participants must register for the workshop in advance so that preparations in response to their interests may be addressed through the workshop's activities.

The workshop will begin with a guided thirty-minute reflection and discussion activity to reveal remote learning challenges of participants. Following this reflection-discussion, during the next thirty minutes, facilitators will introduce terminology and concepts to serve as a shared vocabulary for discussing cross-sensory prototyping. These include affordances-based theories (Gaver, 1991) and example projects that apply these, such as Biggs et al. (2019), Ghodke et al. (2019), and Kamat et al. (2022). Participants will be invited to discuss these examples, noting themes.

In the final ninety-minute co-design session, participants and facilitators will collaborate to develop cross-sensory prototypes, strategies and recommendations using everyday household materials. Additionally, custom and commercial software providing 3D virtual environments with auditory-visual annotation features [1, 2] will be available for more refined ideas. Finally, a thirty-minute discussion to wrap up the workshop will be held to give participants an opportunity to reflect on what was produced in the co-design session, compare their results with others, and consider next steps.

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[1]Cross-Sensory Mixed Reality Authoring (CSXR) software developed in collaboration with SenseTech Solutions

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