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Impact Sheet

Alberto, R., van Helden, G., & Bakker, A. (2022). Action-based embodied design for proportions: From the laboratory to the classroom. *Implementation and Replication Studies in Mathematics Education*, 2(2), 174–207. DOI: 10.1163/26670127-bja10008

1 Problem Addressed

Embodied learning technologies (ELT) view the body's interaction with the physical, material, and cultural environment as essential to mathematical cognition (Radford, 2014) and capitalize on this by designing interaction with motion-responsive devices such as touchscreens and Kinect sensors (Abrahamson et al., 2020). ELT have shown efficacy in laboratories with ideal supportive conditions, but their effectiveness in classroom with "real-world" constraints is yet understudied. Along with systemic questions about ideology, theory, and professional development, the laboratory to classroom transition brings about variance in how the programs are engaged due to (1) methods to "up-scaling" designs to serve not one or two but thirty students, (2) students of varied abilities interacting under less continuous supervision by teachers who are less familiar with (or convinced of) the embodied pedagogy (Abrahamson et al., 2021), and (3) a variety of local contexts and conditions inherent in any setting change and thus far not captured by laboratory studies (Cai et al., 2020).

Alberto et al.'s (2022) study is one of the first fine-grained explorations of the laboratory-classroom transition of ELT. The study explores two questions inspired by the innovation implementation framework proposed by Century and Cassata (2016). First, which action-based core components revealed in laboratory investigations of ELT are enacted by students and teachers in the classrooms, and to what extent? Second, what factors, in terms of the individual, the environment, the technology, and the support strategies, could potentially influence ELT enactment differences across settings?

2 What Is Implemented?

Alberto and colleagues apply the innovation implementation framework to compare the classroom engagements of elementary school students and

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teachers with *Action-Based Embodied Design for proportions* with engagements from a similar laboratory (Duijzer et al., 2017) and a classroom (Negrete, 2013). The ELT implemented was the bar version for proportions operationalized on tablets. Three proportion tasks were included in the digital tool: 1:2, 1:3 and 1:4. In the implementation process analysis, deviations from the "laboratory model" are analyzed, with an emphasis on influencing factors within the spheres of the individuals, the environment, the innovation, and the teacher support strategies.

3 How Was the Implementation Conducted?

The implementation was carried out in two elementary school classrooms (6th grade classroom and a mixed 3rd and 4th grade classroom) in the Netherlands. The same lesson was delivered to all students in their classrooms during one of their regular mathematics teaching hours with their regular teachers. In each classroom, one student pair is described in detail in a series of vignettes from the students' learning paths in the 1:2 and 1:4 tasks. Overall, both classroom pairs solved the tasks in similar ways as students in a laboratory in terms of sensorimotor coordination, with attentional anchors and the reflection upon them playing a central role. However, they had more opportunities to be overtly engaged with their hands and self-directed in including artifacts, likely influenced by (unintended) technological changes and setting-specific environmental affordances. Their teachers' engagements resembled laboratory findings to some extent but showed less perceptiveness to students' qualitative multimodal expressions and more directedness in introducing new quantitative forms of engagements, likely influenced by setting-specific fragmented access and novelty of the embodied pedagogy.

4 Implications and Significance

Alberto et al.'s (2022) study contributes to the emerging body of knowledge on the laboratory-classroom transition of ELT. Because research on ELT until now has mainly concentrated on one-on-one cases with a small group of qualified tutors, the study showcases the importance of understanding how to help actual teachers to embrace ELT in their classes. The study results suggest that although instructional strategies developed and tried in the laboratory setting can be organized in teaching guides, learning to teach with ELT necessitates teacher professional development. The subtle comparisons made in the study

suggest ways of how this professional development can be organized and also suggest directions for future classroom investigations. These include explorations into how distinctive the identified in the study interactions are; how to adapt delineated guidance practices for action-based and other embodied pedagogies, and, more generally, how to strengthen the intrinsic connection between innovation development and implementation research.

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