Bodymarking: Interpreting Embodied Experiences of Spatial Reasoning

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Purpose of Study

This study sits at the intersection of two critical areas of research in mathematics education: spatial reasoning and embodiment. Spatial reasoning has been identified as integral to both general mathematical capability and the potential for individuals to flourish in life beyond formal mathematics education (PISA 2021 Mathematics Framework, 2020). Research on the body in mathematics education varies widely and includes the constitutive role the body plays in the development of mathematical understanding (Davis et al., 2015), how students experience the body in the mathematics classroom (Roth & Thom, 2009), and how our senses, such as sight and touch, influence how we know and do mathematics (De Freitas & Sinclair, 2014). In this study, we employ a novel process we call *bodymarking* (Towers, Markle, & Jacinto, in preparation), which we use to observe and describe everyday classroom actions, such as gesture and gaze, to offer an interpretation of how students use the body to both sense and make sense in a spatial reasoning activity.

Theoretical Framework

We adopt an enactive hermeneutic theoretical framework (Markle, 2021) to interpret students' embodied experiences of spatial reasoning in the mathematics classroom. This framework is founded on the principles of enactivism, which views cognition as a complex phenomenon emerging from interactions between organisms and the environment (Varela et al., 1991. Because our focus is on sensation, we also draw extensively on philosophical developments in carnal hermeneutics (Kearney & Treanor, 2015), which views the body as both interpretable and interpretive.

Methodology

Towers, Markle, and Jacinto (in preparation) developed a fine-grained tool for mapping classroom action and use the tool to record and visualize some common ways students and teachers engage each other through intentional movements of the body (e.g., gesture), gazing, and tool use (e.g., writing). Applying the tool yields a color-coded map of the ways students are oriented towards and by each other and their environments in a given lesson. In this study, we apply the process to two 74-minute video recordings, each focused on one of two small groups of students.

Data

Data were generated in two secondary classes with a total of 36 participants at a large, western Canadian high school. The classes covered topics in pre-calculus and calculus and were part of the school's International Baccalaureate program. All participants had high academic achievement in mathematics. Lessons were designed to elicit embodied and spatial approaches to problem solving (e.g., using origami to solve problems involving quadratic functions) and were video recorded.

Discussion

This study addresses significant issues in STEAM education. In particular, it attends to the role of the body in developing mathematical understanding and speaks to the importance of the spaces and places in which we come to know and do mathematics. Through our analysis, we find that students use their senses when doing mathematics in complex and surprising ways. Specifically,

we note how the senses, such as sight and touch, not only enlist each other at an individual level, but bring us together at the level of the collective. Kearney (2015) wrote of the hermeneutical need to "revisit the deep and inextricable link between sensation and interpretation" (p. 17). The bodymarking process provides one means of opening that link to question and underscores the potential of reimagining of how we view the body in the mathematics classroom.

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