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HOW DO MOVEMENTS OF BODIES AND ARTIFACTS EMERGE IN MATHEMATICS EDUCATION?

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This discussion group is initiated by an international collective of researchers all concerned with embodied processes in mathematics teaching and learning. Operating from different perspectives that consider bodies as partaking in educational processes, we have been offering theoretical rethinkings of cognitive and affective processes in mathematical practices. This discussion group aims to consider the origins of movements performed by students, teachers, and artifacts. We invite group participants to reflect on resources initiating bodily movement and on the agents who perform or share the movement. We hope to articulate the difference between motion and movement as well as when and how movements become recognized as mathematical activity and discourse (language, diagrams, gestures).

Imagine a student who draws the graph of $y=x^2$ on grid paper.

From a theory of dynamic systems that Abrahamson uses to argue for his embodied-design framework, this movement emerges as embodied adaptive coordinations in a complex dynamic system bearing agentive, environmental, and task constraints, such as figural features of the paper (Abrahamson & Sánchez–García, 2016). From a new-materialist perspective that Sinclar elaborates in the mathematics education field (de Freitas & Sinclair, 2014), an assemblage of the student with her capacities, the formula and the paper with the virtual transformation that they imply is actualised towards the graph. From a phenomenological perspective, in which Nemirovsky was engaged for many years (Nemirovsky, Kelton, & Rhodehamel, 2013), objectification of formula includes protention and retention of its usage, and the subject joins intentional horizon of the paper and retention formula usage in fulfilling her intentionality of drawing a graph by moving the hand along the paper. From an embodied cognitive science perspective that is within Walkington's expertise, movement is driven by cognitive processing of the formula that is extended beyond the scalp in a distributed system of activity that includes both explicit use of embodied resources and implicit embodied associations (Walkington et al., 2019). From a cultural-historical account, represented by Shvarts in the team (Shvarts & Abrahamson, 2019), the student's drawing is mediated by cultural artifacts—the paper and the formula—and expresses an ideal (cultural) form of action, which the student appropriated in a previous collaboration with a more knowledgeable other.

Group discussion will draw on a prepared audio-video excerpt from a mathematics teaching–learning episode featuring explicit bodily movement apparently relevant to mathematical conceptualization. Group participants will consider this excerpt to elaborate and debate theoretical perspectives as these illuminate agential sources and implications for practice. In the excerpt, there will be vivid involvement of the students, a teacher, and a technological artifact so that participants could draw their theoretical analysis on the enactment and gestures of all participants and interactive feedback from the artifact. Finally, we will discuss applications of the theoretical ideas to educational design and future research questions.

Planned structure:

Planned timeline	Planned activity	Working format /Responsible person
30 minutes	Introduction: the vision of agency from different theoretical perspectives.	A short introduction and five 5-minutes presentations by each of the team leaders
30 minutes	Analysis of a video excerpt with a movement in technologically enhanced settings from different theoretical perspectives.	Five groups focus on different theories and moderated by a corresponding team leader who screen-shares the video fragment
15 minutes	Exchange of findings between the perspectives.	Moderated by the team leaders
15 minutes	General discussion: The consequences of each theoretical approach for educational design and future research questions.	Moderated by Shvarts

Venue requirement:

The discussion group will be hold in online format. Each participant is expected to use her own computer and headphones. Kindly, avoid multiple participants physically sitting in one room so that conversations in small groups do not disturb each other.

References

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Nemirovsky, R., Kelton, M. L., & Rhodehamel, B. (2013). Playing Mathematical Instruments: Emerging Perceptuomotor Integration With an Interactive Mathematics Exhibit. *Journal for Research in Mathematics Education*, *44*(2), 372.

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