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I have a PhD in Physics (Complex Systems) and a master's in Science Education (History and Philosophy of Physics) from the University of São Paulo (USP). I am an Associate Professor at the Institute of Physics, a member of the Graduate Program in Science Teaching (USP), and the leader of the Science and Complexity Education Research Group (ECCo). I was an elementary school teacher for several years, taught middle and high school, and served as an editor of science and math textbooks.

Over the last 25 years, the research we have developed at ECCo has been

based on the Cultural Historical Activity Theory, the Freirean educational perspective, and complex system theories. Within Science Education, we address issues such as the relationship between activity and consciousness, situated cognition, models of dialogic interaction, physics teacher education, teaching-learning of scientific and quotidian concepts, complexification of concepts and curricula, and history and philosophy of science.

Maximum Possible Activity

From the theoretical perspective, we have investigated CHAT connections with Freire's perspective; for instance, we developed the concept of *Maximum Possible Activity* (Potential Activity), which relates to Freire's idea of *Maximum Possible Consciousness*. This concept aims to identify the subject's epistemological, ontological, and axiological compromises when facing a *limit-situation* they brought into educational activities. In scientific education, limit-situations refer to meaningless science classrooms, reflecting the school's encapsulation that separates scientific activities from the diverse and uncertain wild world activities, particularly those related to problems and contradictions in students' communities. Thus, the Maximum Possible Activity aims to develop conditions for overcoming agentically the contradictions that confine them to educational hopelessness.

Such educational scenarios typically follow pedagogical models where learning the productive processes of science does not serve as a means to transform life. Then, the Maximum Possible Activity aims to overcome contradictions by developing agency in exploring *untested feasibility* – a hopeful open-ended activity objectifying a possible utopia (Camillo & Mattos, 2014, 2017; Silva & Mattos, 2021, 2022).

Scientific-Cultural Activity, concept-activity and genre-activity

Some of our works identify central contradictions in Science Education that are expressed as dichotomic pairs, such as the individual versus collective, epistemology versus ontology, and production versus consumption (Camillo & Mattos, 2014; Rodrigues, Camillo & Mattos, 2014). From this perspective, we criticized recent curricular innovations, especially those related to the STEM (Science, Technology, Engineering, and Mathematics) perspective, which in general do not overcome those contradictions (Camillo, Rodrigues, & Mattos, 2023; de Vries & Mattos, 2024).

The Maximum Possible Activity supports the *Scientific-Cultural Activity* as an expansion of science education activity (Lago, Ortega & Mattos, 2019, 2020), in which the scientific-school object is expanded with the inclusion of new textual, discursive, experiential genres, allowing expand scientific concept's meanings (Mattos et al., 2022; Lopez, Ortega & Mattos, 2021). We based this complexification on the idea that any concept and genre must be supported by an activity – the *concept-activity* (Lago & Mattos, 2021) and the *genre-activity* (Ortega & Mattos, 2018). For us, the genre-activity is an expression of ways-of-being-in-the-world-within-the-world. For instance, to investigate the discursive dispute on the shape of earth (flat or round-earth) raised again in the last

few years, we proposed the *Epideictic-Esperantist genre* (Mattos et al., 2023) to express scientific, pseudoscientific, and religious echo-chamber discursive genre used in social media.

Perturbative Activity

The expansive process of the Scientific-Cultural Activity complexifies concepts beyond their scientific meaning, disturbing the typical school activity. We investigate scientific-cultural activity development as a perturbative process that could disrupt the activity system. Thus, inspired by Perturbation Theory (in Physics), we developed the concept of *Perturbative Activity* as an activity that could perturb the system of activities, disrupting the imprisonment of subjects in a set of reified mediations and expanding consciousness and, dialectically, the activity. In this way, we investigated the perturbative mediators among the hierarchical levels of the system of activities in educational institutions (Santiago & Mattos, 2017, 2021) and in-service physics teachers education courses (Silva & Mattos, 2021, 2022; Camillo, Lago & Mattos, 2022), evaluating the transformations in the communities subjects are inserted. Even during pandemics, we investigated the dialogical processes in teacher continuing education courses (Camillo, Lago & Mattos, 2022; Lago, Camillo & Mattos, 2023) and in basic education students (Santiago & Mattos, 2023).

Complex Curriculum-Activity Sytem

Finally and recently, we investigated curricula as complex systems of activities with several hierarchical levels (de Vries & Mattos, 2024). Considering the curriculum as a complex mediated system enables us to model and identify the interactions between different curriculum frameworks. This approach highlights the mediations between economic and cultural dimensions, expressed as a power dispute between implementing global and local curricula. In this field of investigation, we have conducted historical studies on scientific education curricula disputes in different countries and political situations (Lopez & Mattos, 2024; Lopez, Ortega & Mattos, 2024).

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