DUOS OF ARTEFACTS, A MODEL TO STUDY THE INTERTWINING OF TANGIBLE AND DIGITAL TOOLS IN MATHEMATIC

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The presence of a variety of tangible manipulatives and digital environments in mathematics education is a common occurrence today. Instead of comparing and opposing the two types of artefacts, we are focusing on their combination. What are the specific outcomes of their combination? Are particular combinations fruitful for learning? We propose to conduct this study by focusing on a duo of artefacts, which is a simplified model of these complex systems. We define a duo of artefacts as a specific combination of complementarities, redundancies and antagonisms between a tangible artefact and a digital one in a didactic situation (Soury-Lavergne, 2021). A duo is designed to provoke a joint instrumental genesis regarding both artefacts, and to control some of the schemes and mathematical conceptualizations developed by pupils during its use. Learning is describe in terms of evolution of conceptions in the sense of Balacheff (2013).

This lecture will illustrate the model with two examples of duo of artefacts for primary school, one in arithmetic (Maschietto & Soury-Lavergne, 2013, 2017; Soury-Lavergne & Maschietto, 2015) and one in geometry (Voltolini, 2018). Given the pascaline, a small plastic arithmetic machine, the e·pascaline was designed to form a duo for the learning of place-value base 10 notation of numbers. In geometry, an app about triangles and their construction given the length of their three sides was associated to paper and pencil constructions to design the duo. In both cases, specific feedback of the digital app (developed with the Cabri-elem technology) and haptic and mechanical properties of the tangible artefacts allow for complementarities, redundancies and antagonisms in the duo.

We argue that in addition to being a research tool, duos of artefacts are also a way to support the integration of technology into teachers' practices. We have been able to observe how teachers appropriate, the redundancies, complementarities and antagonisms of the pascaline and e·pascaline duo to manage their students' problem-solving strategies.

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