

## THE ROLE OF REPRESENTATION DEVICES IN THE ALGEBRAIC CONCEPTUALIZATION OF CHANGE: A study with 10 to 11-year-olds

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Initiating the learning of algebra concepts by describing, exploring and analysing graphs, tables, and numbers without using –at first instance- the algebraic code is said to be likely. The aforementioned is possible by the use of representation devices generated by a mediation tool such as a simulator (in this case Math Worlds). In order to do so, an early-introduction-to-algebra model, applied to 10-11 year old students who have not received any former education on the subject, is tested. Motion backgrounds are employed profitably so as to introduce algebra concepts; i.e., the starting point is the mathematics of change by using simulations generated by computer environments such as SimCalc Math Worlds. The algebra concept being examined and reported in this article is the functional relation such as velocity, from reading the position and velocity graphs as well as creating tables; in other words, by exploring and elaborating different representation devices.

The methodology used is basically longitudinal case study developed throughout 3 stages: 1) Design and/or selection of teaching activities aimed at promoting cognitive activities of *formation*, *treatment*, and *conversion* among devices (according to R. Duval's theory of representations), by using simulations of motion phenomena in Math Worlds. 2) An exploratory study aimed at testing a diagnostic instrument and the first sequence of teaching activities. 3) The main study aimed at analysing cognitive processes involved in the construction of algebraic knowledge, which is the result of *conversion* and *treatment* activities among devices.

We will discuss issues arising from two cases (Isabelle and Mario) within the framework of R. Duval's theory, in relation to the use of different representation devices in an early introduction to algebra. In one case, the representation devices and the simulator were used to express concepts that the student (Mario) already had started to build up e. g. the velocity concept as a functional relation between distance and time. While in the other case (Isabelle) the devices were used to get information and to start constructing the velocity concept that will be strengthened in the future. In both cases, we will stress the role that a variety of representations played when constructing or explaining the notion of a functional relationship, in the particular context of motion phenomena (specifically, with a focus on velocity as a functional relationship).

Literature's review was according to early introduction to algebra, the role of representation, and experimental studies with SimCalc Math Worlds.

We want to thank The National Council of Science and Technology in Mexico (Conacyt) for funding the research project "Incorporation of IT to the school culture: the teaching of math and physics in the secondary school" (grant No. G26338S).