INSTRUCTIONAL DESIGN TOOLS BASED ON THE ONTO-SEMIOTIC APPROACH TO MATHEMATICAL AND DIDACTICAL KNOWLEDGE

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We present a set of diagrams in which we summarize the theoretical tools developed under the "Onto-semiotic approach" (Godino, Batanero and Font, 2007) (OSA) in mathematics education, from the perspective of the instructional design. We assume that the focus for the didactic-mathematical analysis should be the mathematical instruction processes, which involve the teacher and students working in a specific mathematical content, within an educational context, and with specific technological tools. We consider three analysis dimensions along the design and evaluation of a mathematics instruction process: phases, facets, and levels of analysis, for each of which the OSA provides specific theoretical tools. The potential of using a base-theory in design-based research (Kelly, Lesh & Baek, 2008) for mathematics education is also highlighted. The system of notions that constitute the mentioned base-theory can help not only to describe the processes and explain the educational phenomena, (goal of a scientific discipline), but also to develop instructional research-based resources (technological design component).

Within the OSA we have built a system of theoretical notions useful for the design and didactic analysis of mathematics instructional process (Godino, Contreras & Font, 2006). We distinguish three planes or dimensions of analysis: (a) The design phases dimension, that includes the preliminary, design, implementation and evaluation phases; (b) The facets dimension, consisting of the epistemic, ecological, cognitive, affective, interactional and mediational facets; and (c) the levels of analysis, where we consider the levels of practices (pragmatic meanings), configurations of mathematical objects and processes, configurations of objects and didactic processes, norms and didactical suitability.

As suggested by D'Amore and Godino (2006), the OSA approaches the didactic-mathematical problems from the epistemic and ecological dimensions. Firstly we problematize the nature of the institutional mathematical knowledge, in the same way that it is done by the Theory of Didactic Situations (Brousseau, 1997) and the Anthropological Theory of Didactics (Chevallard, 1992), two theories which are considered as the OSA starting points. The anthropological assumption about the nature of mathematical objects -conceived as emerging from mathematical practices-, is shared with the TAD, and is complemented by the notion of configuration of objects and processes, which allows a detailed epistemic and cognitive analysis of the

mathematical knowledge involved in the planning and implementation of an instructional process. Moreover, the notions of didactic configuration and didactic trajectory (Godino, Contreras & Font, 2006), normative dimension (Godino, Font, Wilhelmi & Castro, 2009), didactical suitability (Godino, Batanero & Font, 2007) are new tools used in the detailed analysis of didactic objects and processes, the norms conditioning and enabling the teaching and learning processes, and to assess the relevance and adequacy of the various design components and decisions made.

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