KEYWORDS (Tifi, A., 2013)

Generalized Concept Mapping: any form of focused writing that demands & enhances awareness of concepts' meanings, i.e. of their context, generalities or specificities, differences, commonalities, interrelations, and requires reflecting and focusing on the grasp of concepts on real instances. This can be achieved through a combination of strategies among which there is the model based on Novak's concept maps.

Bottom-up Concept Mapping: a reversed form of generalized concept mapping of a complex domain of experience that helps the recognition of the most essential, few superordinate concepts, and the organization of the abstract relations among these concepts, that entail mostly processes of abstraction, summarization, induction and invention. To this latter, for the purposes of science education, we prefer (as more feasible for learners) the use of familiar everyday concepts that can be adopted to describe categories of phenomena, systems or objects in a generalized way, as to say "guided" invention.

Case-Based Learning (CBL). Teaching-learning strategy that bases *pre-concept* learning on *Cases* "as factually-based, complex problems written to stimulate classroom discussion and collaborative analysis. Case teaching involves the interactive, student-centered exploration of realistic and specific situations. As students consider problems from a perspective which requires analysis, they strive to resolve questions that have no single right answer" [CIDDE, (2008)] and no pre-assigned procedure.

Pre-concept. A potential concept of which the children is not yet conscious, or of which the learner has not yet been consciously aware [Vygotsky, (1986), p. 169-170]. This sort of

"prepared" concept can be the result of CBL as well as of top-down direct teaching in the context of CBL. It can be completed, or raised up to the stage of scientific concept, only if the learner becomes fully consciously aware of the interrelation between the rules of use of the word label in the played language system in the learning community and the evolving-different meanings that he or she is associating to that word, through self-engaging in *bottom-up concept mapping* activities or further mediated reflection on CBL activities. These features of pre-concept define the "true concept", or:

Scientific concept as a "regularity in events or objects, or records of events or objects" [Novak & Cañas, 2006] , whose recognition is demonstrated by the deliberate designation with a word label and whose "scientific" attribute is given by the systematization, or placing of the concept within a "hierarchical system of interrelation" of other concepts, thus permitting "conscious and deliberate control" of it [quotes from Vygotsky (1986) p 171].

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