



# Mapping Modeling-based Learning in Early Childhood Education

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## Abstract

Models are considered integral parts of scientific literacy, reflecting educators' efforts to engage students in authentic Modelling-based Learning (MbL) approaches in science and mathematics. In this context, learning takes place via students' construction of models as analogical representations of physical and mathematical phenomena. The modelling process involves four steps: (a) making systematic observations and/or collecting experiences about the phenomenon under study, (b) constructing a model based on observations and experiences, (c) evaluating the model against, predictive power, and/or explanatory adequacy, and (d) revising the model and applying it in new situations. Despite the consensus in literature about the usefulness of this approach, MbL is not commonly incorporated into educational practice, especially in early ages.

This is a descriptive case study, aiming to develop rich descriptions of young children's engagement in MbL in various contexts in science and mathematics. In doing so, we analysed videotaped conversations and children-constructed models from 7 classes of 4,5-6 year-old children. Each group investigated a topic in science or mathematics for about a month. Teachers collaborated with the authors to develop learning sequences for studying their chosen topics, with the only requirement to use some aspect of MbL in their sequences. Videos were analysed in order to gain better insight in children activity patterns while engaged in MbL.

Findings highlight two different ways that learners can successfully engage in MbL approaches in early childhood education. The first way is essentially using the MbL approach as the means for learning, acquiring experiences and developing conceptual understanding. For instance, one group investigated the functions of the parts of plants, a second group investigated the function of the simple electric circuit, inventing the idea of something (electrons) moving in the circuit as the agent causing the bulb to light. A third group acquired experiences about the properties of the circle through the process of developing representations of carriages, another group developed conceptual understanding of parallel lines through their effort to construct trapeziums and a last group developed representations of the properties of positive and negative numbers through the construction of an elevator. Second, data show that modeling can be also incorporated as a tool for helping children organize and represent the outcomes of a learning process. For instance, one group spent considerable time investigating magnets and their various characteristics, and end up creating a 3-D structure that summarized all those characteristics. A second group after the involvement in a pizza problem found ways to physically represent a circle. Based on these findings in addition to the different means used for the construction of the models (artifacts -3d representations, drawings and physical representations) we will discuss the common ground identified between constructionism, modeling and the Reggio Emilia/project approach.

**Keywords:** modelling, early childhood education, mathematics, science