

**Reference to Doctoral Thesis by Giannamaria Manno:
*Embodiment and A-didactical Situation
in the Teaching-Learning of
the Perpendicular Straight Lines Concept***

The Thesis by Giannamaria Manno consists of the following parts:

Abstract
Introduction
Chapter 1. The Theory of Situation
Chapter 2. Conflict Between Mathematical Language
and Everyday Language in Students
Chapter 3. A Teaching Proposal
Chapter 4. The Embodiment Theory
Chapter 5. Learning: A Neuronal Approach
Bibliography

In the Introduction G. Manno describes a brief history of her research. The first hypothesis of her research regards the understanding of the function concept by students in the last year of their secondary school. From this research it results that the understanding of the subject is strictly linked to the language set students know best; moreover, it is related to the coordination between the used language sets. The author says: "I believe that the analysis of the relation between natural language and mathematical language should start from the early classes". For this reason she decided to study the relation between these two languages and problems connected with them at primary school (children aged 5 to 10). The author has chosen a micro-problem, i.e., a word having one meaning in natural language and another one in mathematical language. The choice mentioned is the relation between perpendicularity and verticality.

As Mss Manno declared on p. 23, the field research was realized from March 2004 to April 2004 (SPORA project, school centre Ferrara, Italy), following the idea that Brousseau (1996) presented in his "theory of the situation". So Chapter 1 is devoted to the mentioned theory. The author, using the ideas of Brousseau, Spagnolo and others, describes the different aspects of this theory such as didactical contract, devolution, a-didactical situation and its steps, obstacles in theory of situation, etc.

At the end of the chapter "cognitive conflict in obstacle theory" is explained, giving two examples. The first one is the problem "draw heights of obtuse-angle triangle" which implies the second problem: "draw the line perpendicular to line r from the point P ".

Chapter 2 deals with the conflict between mathematical language and everyday language among students. Using bibliographical sources, the different aspects of this conflict are described.

The core of PhD thesis is found in chapter 3. As it was mentioned above, the aim of the author was to study the relation between perpendicularity and verticality within different phases of learning. Mss Manno first characterized research object,

research goals and research tools, then she described the research of her own. In the first stage of her research, the so-called Tom and Jerry test made of four questions was given. In the second one, it was created some a-didactical situation, called play-path where students had to play Tom and Jerry characters. The table with students and teachers involved in the research project is also shown. The author made test analysis, a-priori analysis with evaluation criteria for the quantity analysis, then quality as well as quantity analysis of obtained data (first on a sample of 33 students, then on a sample of 73 students) using a program for PC. The results of the experiments have been illustrated by creating some graphs (similarity tree; implicative graph).

In conclusions of the experience (see pp. 69–74) the author firstly formulates three hypotheses **H1**, **H2** and **H3** (see p. 69) and then describes the answers, which are possible to derivate by using results from Tom and Jerry test.

Chapter 4 is concerned with the embodiment theory. The author describes the main features of this theory such as strong and weak aspects of embodiment theory and their applications on mathematics (world interaction defined math properties, embodied math properties, etc.) Finally, according to the embodiment theory, a scheme on p. 94 shows the relationship between the plumb-line experience and an abstract concept of uprightness and, on the other hand, between the concept of minimal distance and the abstract concept of perpendicularity.

Chapter 5 deals with a neuronal approach to learning. The autor begins with general considerations, continues with "egocentric" and "allocentric" references, natural reference systems: gravity, and ends with conclusions concerning the Euclid geometry and so on. (see pp. 110–112).

From what was said above, it is clear that Mss Giannamaria Manno is able to organize and realize a significant experimentation in the theory of teaching mathematics.

In my opinion, the Thesis by Giannamaria Manno fulfils all the conditions for gaining the PhD degree; therefore, it is recommended.

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