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This work analyses the changes in the relationship between arguing and images from the mathematics textbooks for the secondary school in Argentina along 67 years. The textbooks have been published in the period 1940 thru 2007. The analysis is done by (N=137) textbooks based on three meta-categories in an inductive way. A factorial analysis of multiple correspondences was performed to find the main similarities and differences between the textbooks and to make a cluster analysis and one possible classification.

Keywords: Textbooks, mathematics education, secondary school.

Introduction and conception of arguing

In 1994 an educational reform was performed in Argentina. The syllabus was changed and the scholar textbooks were adapted to the new educational system. The main modifications were realized in the properties of the images more than in the content. The characteristics of the text books, the ideas about argumentation and the characteristics of the images in the books are analysed. This research adopts an idea of arguing that emphasizes the relevance of the divergences between different points of view and the epistemological function of arguing, proposed by Leitão (2007). Different from other theories as Schwarz, Hershkowitz & Prusak (2010), Driver, Newton & Osborne (2000); Leitão proposes that arguing has to be analysed based on three elements: *"argument, argument against and response"* in order to generate confrontation between *argument* and *argument against*, to achieve construction of knowledge and transformation of perspectives in the subject (*response*). These processes occur into face to face situations, or in negotiations of the different points of view with ourselves, in this case, when we are reading a textbook.

Methodology, categories of analysis and some results

A set of (N=137) mathematics textbooks is selected by means of purposive sampling techniques. The analysis was performed starting from a previous qualitative inductive categorization based on three meta-categories:

A- Characteristics of arguing. A1- *Commencement of arguing*: *Questions* or situation, which will be answered later; *Definition*, using to introduce knowledge; and *Examples* to formulate knowledge. A2- *Type of arguing*: *Deductive formal*, used deductive mathematics argument (definition, theorem, hypothesis, theory, demonstration, etc.); *Deductive informal*, they do not reach the formalism of the demonstrations; and *Inductive* that generalize knowledge from a single case. **A3**- *Degree of arguing*, cognitive conflict promoted by the text is analysed in three levels: *High*, books that generate explicitly confrontations, without solution in the text; *Low*, textbooks generate explicitly a cognitive conflict, solved later; and *Absent*, textbooks that inform without questioning.

B- Relationship between the images and arguing (Otero, Moreira and Greca, 2002): **B1-** *Use of the image: Ornamental*, images used with a decorative aim, not related to the content; and *Argument*, used as source of information, knowledge can be derivative. **B2-** *Type of image: Mathematical representations*, use mathematical systems of representation; and *Non-mathematical representations*, images not related with mathematical content. **B3-** *Grammatical style of the images*: *Conceptual*, represent relations and fixed characteristics between the represented elements; and *Narrative*, identify actions between objects that can represent a relation between them in the image. **B4-** Relationship with the "real world": *Naturalist*, images referring to the empirical world, detailed and complex; and *Abstract*, not referring to the world that we experience.

C- Characteristics of the textbooks: **C1-***Date of publishing*: *Period 1*, 1940 thru 1973, *Period 2* 1974 thru 1994 and *Period 3*, after the reform, until the year 2007. **C2-** *Educational level*: refers to the educational level the textbooks. *Level 1*, students between 12 and 14 years old; *Level 2*, students between 15 to 17 years old; and *Level 3*, older than 18 years old. **C3-** *Mathematical traditions* (Klimovsky & Boido, 2005): Computational, emphasis in the resolution of problems and calculation with numbers; *Axiomatic*, present the mathematics demonstrations steps; and *Structuralist*: books that search of regularities that meet the same conditions.

Using this categorization, a qualitative description is made, which originated a first analysis. Then, the categorization is transformed in a group of nominal variables and modalities using Exploratory Data Analysis (Lebart, Morineau, 2000). A Factorial Analysis of Multiple Correspondences allowed the selection of one possible classification in three classes. In addition, a test of randomness to analyse the reliability of the sample was performed using the statistical software SPAD.

The analysis explains changes in the images and arguing, given by: books that propose questions, or only definitions and examples, by the way to conceive and validate to mathematical knowledge, and mainly by the changes in the images and the relation between images and knowledge. The goal of most books seems to be informative. This explains the absence of questioning and discussing about several points of view, and the low level of arguing and conflict found within them.

References

Driver, R., Newton, P., & Osborne, J. (2000). Establishing the norms of scientific argumentation in classrooms. *Science Education, 84*, 287-312.

Klimovsky, G., & Boido, G. (2005). *Las desventuras del conocimiento matemático: Filosofía de la matemática una introducción*. Buenos Aires, Argentina: A-Z editora.

Leitão, S. (2007). Processos de construção do conhecimento: a Argumentação em foco. *Revista Quadrimestral da Faculdade de Educação Pro-Posições, 18, 3*(54), 75-92.

Lebart, L., & Morineau A. (2000). *Système SPAD, Versión 4.51*. París, CISIA-CERESTA

Otero, M. R., Moreira M. A., & Greca, I. (2002). El Uso de Imágenes en Textos de Física. *Revista Investigaciones en Enseñanza de las Ciencias, 7*(2), 127-154.

Schwarz, B. B., Hershkowitz, R., & Prusak, N. (2010). Argumentation and mathematics. In C. Howe & K. Littleton (Eds.), *Educational dialogues: Understanding and promoting productive interaction*, (pp. 115–141). London: Routledge.