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STUDENTS' USE OF CALCULUS FORMALISM AT THE FIRST YEAR UNIVERSITY

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In this conference, I address the issue related to the use of formalism at the first-year university. The epistemological aspects of the quantification (Frege, 1879; Russel, 1910; Quine; 1950; Copi, 1954) highlighted the complexity for students to deal with quantified statements. The ideas underlined by these statements are generally disconnected from natural human experiences.

For instance, concerning the concept of continuity of functions, the question is: To what extent the natural language could bear on the formal definition of this concept. As mentioned by Dubinsky and Yiparaki (2000), students have difficulties to understand statements with mixing quantifiers, and they are in general not able to make a clear distinction between AE and EA statements. More and more, students had quite better understanding of AE statements.

In this sense, I choose the cornerstone concept of least upper bound (supremum) of an ordered set, which is formally expressed via EA statements. My aim is to go beyond Dubinsky and al. results and to focus on the students' work with such statement. I will particularly discuss the definition of this concept given by Schwartz (1991) in a natural language:

"On dit qu'une partie A de E admet une borne supérieure si l'ensemble de ses majorants admet un minimum, et ce minimum est appelé borne supérieure de la partie considérée. La borne supérieure est donc le plus petit majorant ; tout élément qui majore A majore aussi sa borne supérieure." (Schwartz 1991, p. 83)

This conference is divided into two parts. In the first part, I will present a logical formalization of the objects and structures which intervene in the definition of the least upper bound. In addition, I will analyze some handbooks and notes of courses around this concept. The results of this first step permitted to set up the characteristics of relevant experimentation with students. This experimentation revealed two major results: the first is related to didactic phenomena concerning the alternation of quantifiers; the second one strengthened students' difficulties in the mobilization of the definition of the objects and the structures.

References

Chellougui, F. (2009). L'utilisation des quantificateurs universel et existentiel, entre l'explicite et l'implicite. *Recherches en didactique des mathématiques*. Vol.29, n°2, pp.123-154. La Pensée Sauvage Editions.

Copi, I.M. (1954). *Symbolic Logic*. Hardcover, NewYork.

Dubinsky, E & Yiparaki, O. (2000). On student understanding of AE and EA quantification. *Research in Collegiate Mathematics Education IV, CBMS Issues in Mathematics Education*. 8, pp.239-289. American Mathematical Society: Providence.

Durand-Guerrier, V. & Arsac, G. (2003). Méthodes de raisonnement et leurs modélisations logiques : Spécificité de l'analyse. Quelles implications didactiques ?. Recherches *en Didactique des Mathématiques*. Vol.23, n°3, pp.295-342. La Pensée Sauvage Editions.

Frege, G. (1879). *Idéographie*. Librairie philosophique. Traduction française de Corine Besson. Vrin, Paris 1999.

Quine, W.V.O. (1950). *Methods of logic.* Holt, Rinehart & Winston. Traduction française Armand Colin, 1972.

Russell, B. (1910). *Principia Mathematica*. Traduction française in RUSSEL, Ecrits de logique philosophique. PUF. Paris 1989.

Schwartz, L. (1991). *Analyse I.* Théorie des ensembles et topologie. Hermann.

Selden, J. & Selden, A. (1995). Unpacking the logic of mathematical statements. *in Educational Studies in Mathematics.* 29, 123-151.