STUDENTS´ UNDERSTANDING OF AREA AND DEFINITE INTEGRAL CONCEPTS WITHIN AN ENHANCED COMPUTER LEARNING ENVIRONMENT[1]

M. Camacho	R. Depool	M. Santos-Trigo
University of La Laguna	UNEXPO	CINVESTAV
Canary Islands. Spain	Barquisimeto. Venezuela	México

This study investigates what first year engineering university students showed after they had taken a calculus course in which they used systematically Derive Software to work on a series of tasks that involve numerical, graphic and algebraic approaches. In particular, students had opportunity to use a special designed Utility File as a means to approximate areas of bounded curves (via the use of rectangles, trapezoids, and parabolic regions). Fundamental research questions included: *To what extent do students display relationships between graphic, algebraic, and numerical representations in their problem solving approaches? And what type of difficulties do students experience as a result of using Derive and Utility File?*

Basic ideas that helped frame the study recognize that the use of CAS functions as a cognitive tool for students not only to solve problems but also to make sense and understand mathematical ideas; besides, this type of tools provides students the opportunity to generate new mathematical representations that help them investigate relationships associated with a situation or phenomenon in study and to appreciate the balance between formal and informal mathematics (Heid, 2002). Thus, the use of representations plays a fundamental role in students´ construction of concepts (Goldin, 1998). Thirty-one first year engineering university students participated in the study. The study was carried out during one term meeting six hours a week plus two hours of computer lab session. Results indicated that some students relied on the use of the software as a means to validate their paper and pencil work, other group of students used the software to graph and calculate approximated areas and a third group of students combined both paper and pencil and software approaches to solve problems but often failed to connect concepts that appeared in the study of the definite integral with basic ideas (and procedures) previously studied (area of simples figures). Although the use of the software provided an interesting window for students to free them from memorizing formulae or calculations procedures it is also important to recognize that students need time to mature and develop a robust conceptual understanding of the definite integral.

Goldin, G. A. (1998). Representations, learning, and problem solving in mathematics. *Journal of Mathematical Behavior, 17*(2), 137-165.

Heid, M. K. (2002). How theories about the learning and knowing of mathematics can inform the use of CAS in school mathematics. One perspective. *International Journal on Computer Algebra in Mathematics Education*, 9 (2), 95-112.