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The teaching of logarithms in upper secondary school from a historical perspective

Abstract

Secondary school students (16 – 17 years old) face difficulties on constructing a structured mental scheme for the concepts of logarithm and logarithmic function. This presentation focuses on a didactic intervention following Jankvist's module approach and utilizing the history of mathematics (HM) as a tool for the conceptual understanding of mathematical concepts and more broadly as a goal for the perception of the human and evolving nature of Mathematics. Apart from the HM, which has already been used in the teaching of logarithms, the collaborative teaching method and the GeoGebra software were also used in this intervention. This small scale study aimed to address the following research questions: a) Does the use of HM as a tool affect students' conceptual understanding of the logarithmic concepts? b) Does the HM have the potential to be also promoted as a goal for students to even partially approach Mathematics as an evolving cultural product?

The students dealt with the new concepts by participating in a presentation of the logarithmic evolution and by studying historical texts by Leonard Euler. Although the study of an original text is a very demanding and time consuming task, these texts written in a less formal and refined language, clarified, uncovered and extended the mathematical understanding. The students working in groups developed a dialectical relationship with the historical texts by interpreting the symbols and applying the definition and logarithmic properties to specific and generalized examples. The texts came out as cognitive tools functioning as development sources of the semiotic, instrumental and discursive dimensions of the work. Students combined elements of historical texts, on the notion of function, with modern application of the logarithmic function in seismology. They carried the work in a digital environment, reversed the variables in the exponential form ending with the logarithmic formula and matched the different graphical representations to the inverse functions, working both in graphical and algebraic ways.

After the intervention, students responded individually to two anonymous questionnaires about the use of HM and the knowledge they gained. The responses to the worksheets, the recording of the discussions in the groups and the plenary sessions, as well as the answers to the questionnaires show: a) a satisfactory application of the knowledge acquired, b) positive views about the use of HM, and c) awareness of the necessity of mathematical concepts' existence and their evolutionary character. The use of the HM expanded students' motivation by highlighting the initial necessity of inventing and using logarithms, as well as their utility in modern reality. In addition, the exponential process that originally dominated students' work gradually gave its place to direct references to logarithm as a number-exponent. Finally, the study of the historical texts along with that about the elements of the logarithmic evolution preceding Euler's definition helped students to internalize the exponential process into the mathematical subject-logarithm, to understand its functional form as a process of co-variation inverse to the exponential, and to construct their own evidential process by using Euler's logical reasoning.

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