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Ganita and kuttaka: the calculation of Indian mathematics in the classical period (400-1200)

Abstract

Between the 4th and 5th centuries there was remarkable mathematical activity in India related to astronomy, which produced the *siddhantas*; namely, texts with instructions to calculate positions of the celestial bodies and solve questions related to the calendar and astrology, which included whole chapters devoted exclusively to mathematical calculus (*ganita*).

While continuing this tradition, two Indian astronomers and mathematicians, Aryabhata (476-550) and Brahamagupta (598-668), wrote their siddhantic texts, *Aryabhatiya* and *Brahma-sputa-siddhant*a, which were a reference to astronomers and later mathematicians. In Indian mathematics, *Aryabhatiya* played in a certain way the role played by the *Elements* of Euclid in Greek mathematics.

The authors of the *siddhantas* wrote their work following a structure established by the different astronomy schools and included some chapters dedicated exclusively to calculation in the proper mathematical sense. For example, of the twenty chapters of the *Brahma-sputa-siddhanta*, chapter twelve is dedicated to calculation with numbers and chapter eighteen to calculation with unknown quantities.

In this presentation we will focus on some of the issues related to Aryabhata and Brahamagupta calculation. High school students can study them because it allows them to establish bridges between the current methods of resolution and the old Indian methods (inversion method and *kuttaka*). In this way we can contribute to the development of one competence in the mathematical field, in particular the competence related to the dimension of connections and those of communication and representation.

We will present a proposal of a didactic sequence. The didactical sequence starts with the calculation rules with positive, negative and zero (introduced by Brahmagupta), passes through the resolution of linear Diophantine equations, using the *kuttaka* method and ends with the construction of pairs of solutions in the case of a second degree Diophantine equation.This proposal was also presented in our classes during the teacher-training master, in the academic year 2017-2018.

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