Chapter 1

CALCULATORS IN MATHEMATICS EDUCATION: A RAPID EVOLUTION OF TOOLS, WITH DIFFERENTIAL EFFECTS

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Abstract: The appearance of more and more complex tools in mathematics classes is not a response to an institutional need of school. It is, rather, the expression within this institution of a huge social phenomenon (the increase in the number of screens and machines) arising from the utilization of computerized tools by certain branches of mathematics and science.

Alongside other computation tools, calculators have been taken into account in very different ways within the educational institution:
- students rapidly appropriate them, regarding them as of potential assistance to their mathematical work;
- teachers hesitate to integrate them in their professional practice;
- the French mathematics curriculum attempts to promote the utilization of these tools.

However, the spread of calculators raises various questions (about assessment, for example) and provokes lively discussion within professional associations.

Key words: Assessment, Computation tools, Curriculum, Mathematics evolution.
1. A SIGNIFICANT TECHNOLOGICAL EVOLUTION

1.1 Evolution of tools in Mathematics Education

For a long time, mathematics could be distinguished from other scientific disciplines by the economy and stability of the tools used in its teaching system: pencil, ruler, set square, protractor and compasses for geometry, and only pencil for computations (in western countries anyway); in Asia, other artifacts like the abacus were (and sometimes remain) widely utilized. Most probably, this apparent stability masks significant ruptures: the nature itself of the ‘pencil’ used for written computation may have significant effects on learning processes. Lavoie (1994) pointed out the revolution provoked by the introduction of the ‘iron quill’ and the pencil in Canadian schools around 1830:

One of the reasons why the learning of writing was traditionally placed late is precisely the use of goose quills. Indeed, these tools required such dexterity to cut and use that it was normal to delay their use (...). Consequently, iron quills induced a real revolution, the learning of writing and thus of arithmetic in primary schools.

In the twentieth century, tables of numerical values and slide rules were added to these traditional tools for the scientific classes of secondary schools. Effectively, from 1925 to 1975, these tools, strongly recommended by the educational institution, were introduced by teachers and used by students for computation:

- since 1975, this situation has evolved radically. Software permitting numerical or formal computation and geometry has become accessible. The spread of small individual computing tools, calculators, has rapidly and profoundly modified students’ equipment in mathematics classes. In 1975 ‘desk calculators’ appeared, scientific and programmable calculators in 1980, graphic calculators in 1985, and symbolic calculators (provided with CAS and sometimes also with geometrical software) in 1995. When they appeared, graphic calculators cost ten times more than mathematics textbooks. Twenty years later, the cost of these two objects is similar. Tools are more and more complex, their ergonomics and performance are clearly improved, at lesser and lesser cost;

- the spread of new tools is more and more rapid. To equip all students with scientific calculators took fifteen years (from 1975 to 1990), whereas, for graphic calculators, ten years was enough (from 1990 to 2000). If this evolution carries on\(^1\), one can anticipate most students in scientific secondary classes soon being equipped with symbolic calculators\(^2\);