

A case study on the teaching of mathematics in the Italian Renaissance: Niccolò Tartaglia and his *General Trattato*

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Niccolò Tartaglia (1449-1557) is well known in the history of mathematics thanks to the discovery of the solving algorithm of the third degree equation and also for the controversies about the authorship of this result, at first against Girolamo Cardano and then against his pupil Ludovico Ferrari.

Maybe less known, but certainly no less important, it is his activity as Abacus Master (*maestro d'abaco*), attested in Verona since from 1529.

Shortly after Tartaglia moved to Venice where, in addition to his teaching activity, he held public readings on Euclid's *Elements*, that earned him some fame.

In Venice, Tartaglia started to print his books; the last treatise, partly posthumous, was the *General Trattato di numeri et misure*. Divided in six *Parti* (Parts), printed between 1556 and 1560, it was a real encyclopedia in which matters and methods of mercantile mathematics coexist with mathematical humanism, represented for example by the translation in vernacular of the First Book of the Archimedes' *Sfera e cilindro*.

Even if the *General Trattato* can't be considered as a textbook, in it we find many observations which help to partially retrace Tartaglia's ideas on the teaching of mathematics.

To bring his readers – practitioners like artisans, merchants, architects, soldiers and so on – to a mathematics more speculative than the one they were used to, Tartaglia relied on a language rich in metaphors and similes taken from daily life. For example, when he explained the general meaning of 'measuring a surface' he evoked the figure of a shoemaker who 'measures' a piece of leather (the surface) placing upon it the model of a sole (the unit of measure) several times until its very end, so to see how many shoes he was able to make.

Definitions are similarly conceived and they are, when possible, anchored to the real world, so that they will be of some practical usefulness: this approach is easily successful with the geometric definitions of genetic type.

The particular attention that Tartaglia paid to the language is also the fruit of his activity as both a translator and a teacher. It is in fact important to remember that he was the first to publish Euclid's *Elements* in a current language, that is the Italian vernacular.

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The meeting point between Tartaglia-the-translator and Tartaglia-the-abacus-Master, gives rise to surprisingly modern reflections about possible obstacles aroused by the use of the common language in the learning of mathematics.

The attention that Tartaglia paid to the use of mathematical language in the process of learning, it is just one of the features of modernity that clearly emerges from the reading of his works. Another aspect of high interest concerns his approach to problem solving. We can briefly take an example into account.

Facing a typical problem of surveying, as that one to determine the area of a triangle whose sides' length is known, Tartaglia presented different strategies of resolution, that are represented by different formulas to be chosen in relation to the concrete context in which we need to apply them.

A first approach, for example, is to determinate the height of this triangle using the propositions 12 or 13 of Books II of Euclid's *Elements* depending on whether the triangle is obtuse-angle or acute-angle. As an alternative, Tartaglia suggested the use of so-called "Heron's formula", of which he also provided the proof - an unusual mathematical 'object' in a practical geometry treatise - aimed "to satisfy speculative people".

There is also another interesting expedient that Tartaglia used to focus his reader's attention on the resolution procedures. The *examotage* is to consider every example with the same numerical data, in other words to consider the triangle of 13, 14, 15 sides length. These numbers allow to make simple calculations and to not to deflect the attention from the comprehension of the resolution procedure. Only after that the procedure has been completely internalized, more complex calculation can be introduced.

To conclude, even if the *General Trattato* could not be considered a teaching handbook, the examples we can find highlight some interesting ideas of the Master Niccolò da Brescia on teaching and learning mathematics. A purely mnemonic learning, in other words a learning not subordinated to the comprehension of the processes, it was liable to fade out in a short time without leaving any trace in the learners' mind. It is for this reason that Tartaglia offered to his readers also the possibility to explore the causes that are behind the rules.

Maybe the most significant pedagogical effort is the attempt to educate to abstract mathematical reasoning a public mainly interested in "useful" results, immediately employable in everyday life. Tartaglia addressed his work to these readers using a strongly evocative language and an approach rich in metaphors in which the readers can easily recognize the surrounding world and so can clearly perceive the mathematical laws hidden in their daily life. A message that after so many centuries has not yet lost its efficacy.