# A CASE FOR A STANDARD MATH EDUCATION IN ANCIENT ROME

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## Abstract

Although overshadowed in the ancient Roman sources by the importance given to grammar and literature in a child's school curriculum, secondary instructors of rhetoric and philosophy frequently required their pupils to have a certain level of numerical familiarity. This requirement was demonstrated by Quintilian, who believed that mathematics were "essential not only to the orator, but to anyone who has had even a basic education" (Quint. Inst. 1.10.35). This study investigates what comprised this basic math education, and how, why, and for whom this curriculum was implemented across the unregulated educational institutions of late republican and imperial ancient Rome. Modern scholarly discussion on mathematics in early Roman education is limited, as the ancient sources have left us only fleeting mentions of math in the classroom or in practice. Through analysis of these references, widely scattered throughout ancient literature, I construct a probable mathematical lesson plan to determine what arithmetical operations and skills, such as rationality and finger reckoning, were expected of Roman children to become numerically competent adults. These texts not only provide glimpses into the Roman classroom and the teaching methods within it, but also allow us to explore ancient authors' varied attitudes toward math and educational institutions.

**M**odern scholarly discussion nearly unanimously agrees that primary education in ancient Rome was more or less the same for all who were able to receive one, consisting of grammar, literature, and arithmetic (Carrier, 2016; Cuomo, 2000; Rawson, 1985). Though the Latin sources are dominated by authors who exalted the language arts above all others, many secondary instructors required their students to have a basic mathematical competency. This requirement is demonstrated by Quintilian, an orator and educator from the early Roman Empire, who believed the youth should have this arithmetical foundation "before being handed over to the teacher of rhetoric" (Quint. Inst. 1.10.1). Despite the scholarly agreement, the question of what the Romans considered this "baseline" mathematical ability, and how it was determined and achieved, is yet to be answered. The delay in modern attempts to establish this common Roman numeracy, or familiarity with numbers and mathematics, can be attributed to the challenges presented in the unregulated and socially exclusive nature of ancient education. As a consequence of this lack of legislated uniformity, there is lack of dedicated sources on teaching or learning math. In the ancient literature, references to mathematics in educational contexts and in practice are few and fleeting, but through their examination, this paper explores the innerworkings of the Roman "classroom," educational system, math curriculum, and sentiment toward numeracy. My research reveals that there indeed was a relatively standard elementary math education in late republican and imperial ancient Rome, shaped by social expectations of numeracy and the necessity of effectively handling finances.

Before discussing of what this standard elementary math education comprised, I will begin by examining for whom this numeracy could have possibly been called "standard." The most educated demographic in ancient Rome was the aristocracy, for this class had the freedom and time to pursue learning (Rawson, 1985), and the means to pay for it. While the vast majority of slaves were not, a considerable number were already educated and made tutors to the aristocracy or chosen to be educated by their owners for their own interests. These educated slaves were capable of fetching higher prices and were thought to be worthy of handling tasks that required more scrutiny and trust (Carrier, 2016). By no means barred from education, aristocratic women were usually given a schooling, but

far less often and not to the same extent as their male counterparts, as they were relegated to household matters more often than not. Practicing any education they did receive was especially difficult for women, however, because most professions and offices were restricted to them on the basis of tradition or social stigma (Carrier, 2016).

Considering these factors, the person who received a math education, or any education at all, was no average Roman. This individual would have likely belonged to one of the smallest demographics in ancient Rome: that of freeborn, aristocratic, male citizens. The exclusivity of education can be visualized in the estimate that fewer than 15% of the population was able to read in even the most literate cities of the early Roman Empire (Harris, 1989). The average Roman who qualified to receive an education did not accurately reflect the greater part of the population, and this fact must be considered in investigating how a single subject within education could be called "standard." These math lessons were given to such a small fraction of the populace, and these lessons likely were not standard either.

Education of children in ancient Rome traditionally took place with tutors at home or in small, local schools called ludi. Rome did not have state-sponsored schools offering state-regulated programs in the same sense that they exist today. These Roman "public schools" were few, could only be found in larger cities, and did not have a regular curriculum (Carrier, 2016). The quality of these schools is represented negatively in literature, and they were usually deemed inferior to a traditional private education. In a letter, Imperial Roman author and magistrate Pliny the Younger recounts his encounter with a father and his son, who was educated away in Mediolanum, the home of one of these public schools (Plin. Ep. 4.13.3). He begged the father to have his son taught in their native city with a local tutor, and Pliny felt so passionate as to even offer to help pay for the boy's education, pointing out the low quality and "evil practices" taking place "where teachers' salaries are paid from public funds." Even Emperor Marcus Aurelius, in his Meditations, denounces public schools, noting the importance of spending money "to enjoy good teachers at home" (M. Aur. Med. 1.4). The bias must be acknowledged, however, as these excerpts, and nearly all of ancient literature, come down to us from privately educated aristocrats. Given the reputation state-sponsored schools had in literature, we must wonder what appeal they had in

Rome. Their operation, despite their infamy, suggests they were likely less expensive than private tutors. Whether Roman children were educated by family-funded tutors or, more rarely, these state-subsidized institutions, the education they received was not regulated by any legislation. The search for a standard elementary math education would have to be a question of what expectations of numeracy were placed on children, and what they had to master to be functioning, mathematically-competent adults.

A few Roman authors have specifically written on the importance of having a mathematical education, though exclusively as smaller topics within broader treatises. Although these authors do not specifically list what mathematical operations must be known to the educated Roman, they do shed light on sentiment toward mathematical capability. Examining these works allowed me to commence my argument for the existence of an expected, and possibly standard, numeracy. In *De Oratore*, Cicero, statesman and writer of the late Roman Republic, discusses the importance of an orator's ability to speak on any subject, including mathematics (Cic. De or. 2.66). He looks fondly upon the great orators of history, such as Hippias of Elis, who claimed that there was "not a single fact with which he was unacquainted," and that he was familiar with each of the vocational and liberal arts, including geometry (Cic. De or. 3.127). While Cicero romanticizes and lauds the well-rounded knowledge of the perfect orator in *De Oratore*, Quintilian actually discusses the pragmatic benefits of numeracy to a speaker in *Institutio Oratoria*. He also tells us that there indeed was a "public opinion" on mathematics in education, though he may disagree with it. He introduces the topic of the orator's math education with his defense of *geometria*, which, given the content of the rest of the topic, is to be safely understood as meaning mathematics in general.

> As for geometry, it can be confessed that some parts are useful to be had in youth, for it exercises the mind, sharpens the wits, and generates quickness of perception. But it is estimated that the benefits come not, as with other arts, when it has been grasped, but only during the learning process. This is the common (*vulgaris*) opinion. It is not without reason that great men have expended enormous effort on this science. (Quint. Inst. 1.10.34)

In this passage, with the use of the word "*vulgaris*," Quintilian disagrees with what he claims to be the "common" or "uneducated" opinion, that the mathematical arts are solely useful for the development of children in their formative years. The fact that this sentiment, with which he opposes, concerning the youth's math education can be called "common" strengthens the case that there indeed was an elementary math curriculum, though its content is still to be examined. Quintilian asserts that the benefits of mathematics transcend the education of children when he says, "Knowledge of numbers is essential not only to the orator, but to anyone who has had even a basic education. It is indeed very frequently involved in actual cases" (Quint. *Inst.* 1.10.35). Here, Quintilian further reinforces the existence of a basic education and the meritorious place mathematics has within it, as well as the fact that math was useful to educated Romans past childhood and outside of the classroom, such as in the court cases he describes. This supports the argument proposed on the existence of social expectations of numeracy placed on the educated, but leaves us to wonder in what mathematical skills and operations these expectations culminated.

Next, through analysis of references in literature, we can distill what a standard elementary math education comprised of in Rome. The references are nearly always made in mere passing, which could suggest indifference on the author's part or, more likely, the ubiquity of certain mathematical lessons in education and what could make up a basic numerical knowledge among the educated. The foremost skill would need to be the ability to recognize numbers and manipulate them in addition and subtraction. An instance of this elementary lesson is preserved for us in Augustine's *Confessiones*, where the late imperial theologian painfully recalls the addition tables he had to recite aloud. He writes of a song that sounds similar to what would be sung in primary schools today: "one plus one is two, two plus two is four" (August. *Conf.* 1.22). He calls it an "*odiosa cantio*," revealing his disdain for what could have been either his least favorite subject in youth or what might have been his annoyance at what had to be recited too often. The ability to count needs no justification to be part of a standard elementary math education, but through this recollection of Augustine, we catch a small glimpse of what the Roman classroom was like. Another peak into the classroom environment, and the growing complexity of mathematical education among what

could be considered to be older students, is given to us in Horace's *Ars Poetica*.

> Our Roman boys, by a long sum, learn in childhood to divide the as into a hundred parts.
> 'Let the son of Albinus answer. If from five-twelfths one ounce be taken, what remains? You could have already answered.'
> 'A third.'
> 'Good! you will be able to look after your means (rem). An ounce is added; what's the result?'
> 'A half.' (Hor. Ars P. 325-30)

In this passage, the early imperial poet Horace does much more than simply share his comments on Roman greed. With these few lines, rationality emerges in the mathematical curriculum, and it appears that Romans learn their fractions through their units of currency. He mentions that this skill is learned in childhood, to say that avarice is inculcated early in a Roman's life, but he also elucidates where to put rationality on our educational timeline. The imagined teacher calls upon "the son of Albinus" to answer the question, which further reinforces the oral aspect of Roman education (Cuomo, 2000), some of which we already saw with Augustine. Upon answering the question correctly, the student is praised by his teacher and assured that he will be able to manage his "means," which could be translated from the Latin as "things," "affairs," "matters," and even "property." With this student's due praise, we are beginning to see that elementary math education in Rome had a practical nature and had goals in asset management. The expectation of being able to count, add, subtract, and divide would translate into the ability to transact and change money, and "look after one's means." I argue that this expectation of competently working with money and other assets, in turn, would shape the mathematical lesson plan that would end up being relatively standard throughout Rome. The elementary math curriculum does not stop there, however. Though the aristocracy may have had the time to dive into the more theoretical end of mathematics, the pragmatic nature of primary school lessons makes way for a skill that I contend was known to most educated people in Rome.

The skill of counting and calculating on fingers, known as finger

reckoning, is widely represented in Roman literature, spanning across letters, treatises, poetry, and even the theater. Roman finger reckoning was quite sophisticated, as seen from the operations described, but the ancient sources did not leave behind any complete sets of instructions to their methods (Williams & Williams, 1995). Some authors wrote, in quick references, how to gesture certain numbers, but the lack of a complete manual despite the skill's presence in literature again attests to both the strong oral aspect of Roman education and what could have been the ubiquitous nature of finger reckoning in math education. The impossibility of knowing how much of this skill was taught to children by their parents at home must also be considered. Examining manuscripts from countries once under Roman influence, however, yields promising results. Medieval manuals on number gesturing do exist from countries as distant as England and Greece, however, and their agreement on method has convinced modern scholars of the likelihood of a correlation between the medieval and Roman approaches to the skill (Turner, 1951), implying there may have once been a standard Roman method.

References to finger reckoning in Roman literature are usually made in passing, such as Palaestrio's "calculating" right hand in Plautus' Miles Gloriosus (Plaut. Mil. 1.203-8), and the "fingers by which we are wont to count," in Ovid's Fasti (Ov. Fast. 3.123). In his defense of mathematical capability in Institutio Oratore, Quintilian mentions the importance of possessing a mastery of finger reckoning in saying, "There the speaker is thought an ignoramus (iudicatur indoctus), I will not say if he hesitates in adding up, but if he contradicts his calculations by shaky and inappropriate movements with his fingers" (Quint. Inst. 1.10.35). Quintilian reveals what would be the humiliation of an educated Roman that is unable to perform what appears to be a common skill. This imagined person giving a speech would likely be surrounded by some of the most influential people of ancient Rome, who would have been able to afford an education. Quintilian plainly says this person would be considered "unlearned," convincingly implying this commonly held education among the audience must have contained finger reckoning.

Literary presence aside, the capabilities of Roman finger reckoning are also quite impressive. In Historia Naturalis, Pliny describes a statue of Janus gesturing 355 with its hands (Plin. HN 34.33-4), demonstrating the skill's quantitative capacity, which starkly con-

trasts with the limits of the average, "modern" fingers. It is also worth mentioning that the medieval sources on finger reckoning, which are likely similar to the Roman style, attest to the ability to count up to 9999 (Turner, 1951). Arithmetical operations were also possible on the educated Roman's fingers, and one of the most popular examples can be found in a letter from Cicero to Atticus, his friend and fellow equestrian class aristocrat (Cic. Att. 5.21.12-13). In it, Cicero relates the story of a disagreement he recently had with someone concerning the difference between a simple and compounding interest, and how Atticus, while reading the letter, ought to already know the answer, "knowing his fingers." It cannot be known if calculating percentages with fingers would have been too advanced to be in an elementary math curriculum, and if Atticus learned the operation later in life, but it is interesting to see what this skill was capable of anyway, especially while reading a letter. How often finger reckoning is mentioned in literature, however, cannot be ignored. On account of this literary presence, how pragmatic it was to be familiar with the skill, and how embarrassing it was for an educated person to fumble at it, I propose finger reckoning had its place in Rome's standard elementary math education and a certain degree of its mastery was expected of the educated.

In conclusion, elementary math education in ancient Rome can indeed be called standard, but only amongst the few fortunate enough to receive it. It may never be known to what extent mathematics were taught to children by their parents at home, but a pragmatic math curriculum can be seen to have existed in Rome's unregulated educational systems. It was observed that the primary purpose of elementary math education in ancient Rome was for the practical skill of effectively handling money, which would have shaped mathematical lesson plans throughout the late republic and empire. Found throughout the literature, the expectation of numeracy placed upon the educated demographics of Rome further establish the existence of this standard math education. Just as there are today, different degrees of numerical expertise could have been found within each individual in ancient Rome (Cuomo, 2012), determined by his or her education, profession, and interests. Very few Romans continued past primary education, as Diocletian's 301 CE Edict on Maximum Prices tells us secondary instructors could charge up to four times more than their primary counterparts (Car-

rier, 2016), making it all the more interesting to examine in what a "basic" math education culminated and what degree of math competency was shared by the majority of the educated in Rome.

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# References

Carrier, R. (2016). *Science Education in the Early Roman Empire.* Durham, North Carolina: Pitchstone Publishing.

Cuomo, S. (2000). *Pappus of Alexandria and the Mathematics of Late Antiquity.* Cambridge; New York: Cambridge University Press.

Cuomo, S. (2012). Exploring Ancient Greek and Roman Numeracy. *BSHM Bulletin: Journal of the British Society for the History of Mathematics,* 27(1), 1–12. https://doi.org/10.1080/17498430.2012.618101

Harris, W. V. (1989). *Ancient literacy.* Cambridge, Mass: Harvard University Press.

Rawson, E. (1985). *Intellectual Life in the Late Roman Republic.* London: Duckworth.

Turner, J. H. (1951). Roman Elementary Mathematics the Operations. *The Classical Journal*, 47(2), 63–108.

Williams, B. P., & Williams, R. S. (1995). Finger Numbers in the Greco-Roman World and the Early Middle Ages. *Isis*, 86(4), 587–608. Retrieved from JSTOR.