"LOGISTIKĒ" AND EPISTEMIC PROGRESS

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Abstract. Plato, in his writings, and in his interaction with the associates of the Academy he founded, never teaches. His goal is not to propose definitive solutions. Rather, his methodological insights are used to recognize a problem where others see just a fact that needs no further discussion. The introduction of the concept *logistic* gives us the chance to reflect on the problem of what calculations are: thanks to *logistic,* relations among numbers are taken into consideration. These relations are what render it possible to calculate. According to Plato, there are two different kinds - theoretical and practical - of *logistic* and arithmetic. *Logistic* and arithmetic, when considered theoretically, focus on the non-sensible. Today, however, the primary goal of mathematical research is no longer centred on the analysis of the intangible. Nevertheless, the Platonic method - his encouragement to view issues from a different, broader perspective - remains a source of innovation even in the contemporary age.

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1. COGNITIVE INTERACTION BETWEEN WRITER AND READER

In my work on Plato and intellectual development (Saracco 2017), I analyzed a crucial passage of his dialogues: that of the sixth book of the *Republic* (*Republic,* VI 509d-511), in which he explains the stages of the intellectual development of human being and what objects of knowledge are pertinent to each phase of cognition. Plato schematizes this idea of intellectual progress using a line segment divided into four subsections: two of them correspond to phases in which our knowledge is still connected to the sensible realm and the

other two sectors indicate a kind of knowledge which is pertinent to the intelligible realm.

My attention was captivated by the moment in which Plato, summarizing his idea of cognitive progress, tells his readers that there is much more to know about the subject than what had been discussed so far with Glaucon (*Republic,* VII 534 a):

> But as for the ratios between the things these are set over and the division of either the opinable or the intelligible section into two, let's pass them by, Glaucon, *lest they involve us in arguments many times longer than the ones we have already gone through*.

Foley (2008, 23), commenting on the previous excerpt from the *Republic,* emphasizes:

> (…) the passage shows that Plato is not willing to set forth his views on the further complexities that have emerged. It is a task that he *intentionally* leaves for his readers, revealing that his final assessment of the role of the divided line is to *force a thoughtful reader to transcend the text*. One significant aspect of the divided line is exactly that Plato refuses to explain its point. (Foley 2008, 23)

Foley's words reveal a crucial insight: Plato's text is a stimulus for a rational investigation which is not meant to *end* in the written words of his dialogues. Stating this, I do not want to associate my theory with the point of view of those scholars who claim that Platonic basic teachings are not part of his written dialogues because they belong to his unwritten doctrines[1]. On the contrary, I do think that the fundamental Platonic teachings are in the written dialogues. Plato uses his writings to ask his readers to actively participate in the text. Such participation is not meant to be a simple approval or criticism of the words of the philosopher; rather, this call for collaboration is designed to "force a thoughtful reader to transcend the text" (Foley 2008, 23). Plato, presenting in the *Republic* his schematization of intellectual development in connection with the objects of investigation that human reason can grasp, tells his readers that there is more to discover on the subject, and this is something that they have to do. In saying this, Plato calls for

collaboration between the writer and the reader. Plato has not written a textbook whose content can merely be summarized by readers. He has created a text to which they are required to respond and the act of responding to the text is as important as the text itself: the two of them together complete Plato's task. Plato does not want to convey a static description of how things are. He has created a text that calls out for completion through readers' further contributions. This does not mean that his words are incomplete, in the sense that they communicate thoughts which have not yet reached a good degree of elaboration. On the contrary, it means that the words written by Plato are so well mastered by their author that they are able to stimulate the reader to overcome them, as Foley highlighted. Plato's texts are composed not only of words, which have the goal of expressing the thinking of their author. They also comprise the thinking of their users.

Through dialogues, Plato is inviting us to reflect on our cognitive resources and develop them autonomously. He says this explicitly in *Meno*:

> As the whole nature is akin, and the soul has learned everything, nothing prevents a man, after recalling one thing only-a process men call learning-discovering everything else for himself, if he is brave and does not tire of the search, for searching and learning are, as a whole, recollection. (*Meno*, 81 c-d)

It is useful to read these lines together with an excerpt from *Phaedrus*, where Socrates is reporting a dialogue about the art of writing between Thamus and Theuth:

> O most expert Theuth, one man can give birth to the elements of an art, but only another can judge how they can benefit or harm those who will use them. And now, since you are the father of writing, your affection for it has made you describe its effects as the opposite of what they really are. In fact, it will introduce forgetfulness into the soul of those who learn it: they will not practice using their memory because they will put their trust in writing, which is external and depends on signs that belong to others, instead of trying to remember from the inside, completely on their own. You have not discovered a potion for remembering, but for reminding; you provide your students with

> the appearance of wisdom, not with its reality. Your invention will enable them to hear many things without being properly taught, and they will imagine that they have come to know much while for the most part they know nothing. And they will be difficult to get along with, since they will merely appear to be wise instead of really being so. (*Phaedrus*, 275 a-b)

Let us connect this passage with the fragment from *Meno* cited above. There, he tells us that learning is a process of "recollection" (*Meno*, 81 d) and in *Phaedrus,* we read that the written words will not help us to remember but they can only be used as *reminders* because they do not lead to ourselves but they rather depend on signs that "belong to others" (*Phaedrus*, 275 a). In *Phaedrus*, Plato explicitly connects the process of learning with remembering something that is inside us: what is inside us makes us remember and recollect wisdom that is merely reminded by written words.

It seems unlikely that the author of these passages would conceive of his own written words as the final destination of knowledge, but rather as a stimulus to reach that destination, which is internal to us. Thus, they are only a reminder of the necessity of looking for knowledge, where the answers to the dialogical questions come from inside us: from the organ capable of remembering which is, for Plato, the soul and its main component, reason. Consistently, Plato's dialogues do not end with the thoughts of the author and the words, the reminders that he has selected to convey them, but they are enriched by the multitude of rational memories prompted by the autonomous investigations of Plato's readers.

The dialogical character of Plato's work is opposite to the will of indoctrinating or just instructing the readers. Plato chose to write dialogues and this choice is not only a formal but also a philosophical one: he wants to stimulate an active participation of his readers, which goes beyond the accidental criticism of written words that can take place whenever a text is read. In fact, as we saw, when Plato, in the *Republic*, presented his idea of what intellectual development is, he explicitly stated that there is more to discover on

the subject. But he does not tell his readers how they should do it. The modes of collaboration between writer and reader advocated by Plato are not predetermined by the philosopher. Plato's readers can choose to criticize radically his philosophical system or they can accept its basics. Plato interacts dialogically with them, asking them explicitly to transcend the text (Foley 2008, 23. Also cf. *Phaedrus*, 275 a-b), to complete it with their contributions. This Platonic request is at the base of the higher-order pedagogy that permeates his dialogues, where the role of the readers is not flattened to that of a student, who can merely absorb the content proposed by the teacher. Plato's readers are invited to become active creators of the philosophical message. This invitation is not to be considered as a consequence of a lack of Plato's argumentative ability. On the contrary, as we have just seen, the philosopher is able to stimulate his readers with explicit requests[2].

For Plato, education has crucial importance. The philosopher is well aware of the fact that human rational nature can diverge from its positive capabilities when its direction is determined by messages that appeal simply to appetite. This intuition is itself remarkable for modernity. But what renders the Platonic rational pedagogy extraordinary is its character: Plato explicitly says to his readers that they have to find the truth by themselves, using what they are reading only as a reminder of the rational power that they possess (*Phaedrus*, 275 a-b). Plato's is a kind of higher-order pedagogy in which readers are not passive receptors of content but they discover themselves as authors of the content.

The dialogue between Plato and his readers takes place *via* the written words of his texts, which allow the continuation of the cognitive exchange between the philosopher's rational heritage and his reader's intellect. The dialogical interaction with readers and the consequent free development of their thinking abilities do not mean that the Platonic philosophy can be developed in any way. The intellectual stimulation of Plato's words consists of the exhortation to contribute originally and creatively to the development of what Plato thinks knowledge is. He tells his readers clearly what his idea

of knowledge is, namely the highest point of intellectual development that is reached when we become able to abandon the empirical completely to reach the purely intelligible. Only when our rationality is disentangled from the distracting stimuli which come from the tangible realm, we can grasp the purely intelligible truth. Nonetheless, the individual contributions of his readers can mould the concept of Platonic knowledge into the shape their intellect suggests. Furthermore, it remains possible for them at any point to use their rational capabilities, sharpened through texts written by the philosopher, to criticize his conception of knowledge or abandon his system.

1.1. A *Method* for Cognitive Growth

We just saw that Plato's dialogues prompt interaction with readers, which requires their active participation with the text: there are no definitive solutions that can be learned by heart but occasions for cognitive growth. This interpretation of Platonic dialogues is in line with the nature of Plato's Academy. We cannot really know what Plato did in his Academy, since external evidence available for the reconstruction is extremely slight (Cherniss 1962, 61-62). Nevertheless, there are facts that can help us get a sense of the interaction between Plato and his associates. Cherniss observes that there were "disagreements among Plato's associates concerning the interpretation of identifiable passages in his dialogues" (Cherniss 1962, 75): for instance, it was "hotly debated the comparatively simple question whether or not the creation - in *Timaeus* - was meant to be understood literally" (Cherniss 1962, 75). This kind of discussion among Plato's associates

> should make us wary of the lazy assumption that, when they seem to ascribe to him notions which are not verbally expressed in his writings, their source for these must have been his oral teaching or discussion (…) the only legitimate conclusion which can be drawn is that Plato himself did not *teach* or discuss the doctrine at all. (Cherniss 1962, 75)

Cherniss' words remind us of Foley's. As we have seen, Foley highlighted that "one significant aspect of the divided line is exactly that *Plato refuses to explain its point*" (Foley 2008, 23), referring to Plato's idea of cognitive progress, schematized using a line segment subdivided into sections. Foley notices that Plato leaves to the reader the task of investigating the cognitive complexities introduced by the line segment and its association with intellectual growth. Cherniss points to the same concept: Plato does not write to make your mind rest; he writes to make it realize what is able to do. In the Academy, no recipe for truth was offered, but this does not mean that it has to be hypothesized the existence of an oral doctrine where these solutions are offered. On the contrary, the lack of definitive solutions to learn is the crucial character of Plato's philosophy. Another example presented by Cherniss contributes to reinforce the idea of the Academy, and of Plato's philosophy, as a place of cognitive stimulation:

> Aristotle asserts that, for Plato, the mathematical objects were a third class of separate entities intermediate between the sensible particulars and the ideas, these mathematical numbers and figures differing from sensibles and resembling ideas in that they are eternal and immobile but differing from ideas and resembling sensibles in that there are many of each kind. All the attempts to find this intermediate class in the dialogues have failed; and it has been positively proved over and over again that Plato does not anywhere in his writings recognize mathematical numbers and figures as entities separate from sensibles on the one hand and from ideas on the other. Many scholars, therefore, have had recourse to the usual hypothesis that Plato must have taught this doctrine orally in the school and that this is the source of Aristotle's ascription. Insufficient attention, however, has been paid to the fact that *Aristotle's own testimony is inconsistent*… the inconsistency of Aristotle's own testimony and the discordant opinions of the different members of the Academy show definitely that *Plato did not* himself "*teach*" his pupils or associates a doctrine of mathematical objects at all and did *not* even resolve their disagreement about the meaning of what he had written on the subject by laying down an *authoritative interpretation*. (Cherniss 1962, 75-78)

This quotation makes us realize that Plato's words were devised to ignite complex debates; in fact, even Aristotle's own testimony

could be inconsistent regarding the interpretation of Plato's words. Nevertheless, Plato has never wanted to provide his associates with a solution to his cognitive riddles. He did not want to teach, offering a definitive solution to a cognitive problem. The different interpretations of his writings, elaborated by associates of the Academy, prove the fact that he has never wanted to end a debate with an authoritative interpretation. Plato's interaction with mathematicians was of the same sort:

> Philodemus says that mathematics made great progress under the direction of Plato, who formulated problems which the mathematicians zealously investigated. Proclus, too, in his famous summary, which appears to derive ultimately from the *History of Mathematics* written by Eudemus, credits Plato's concern for mathematics with the great progress of these studies and particularly of geometry. Besides Theaetetus, Leodamas, and Philip of Opus, he names six specialists in mathematics who, he says, passed their time together in the Academy and pursued their investigations in common. It cannot be imagined that Plato *taught* any of these men mathematics, though he is said to have induced Philip to turn his attention to the subject, to have originated the theorems about the section, the number of which Eudoxus increased, and to have communicated to Leodamas the method of analysis. The last tradition Proclus repeats with obvious hesitation; and the truth probably is, as Tannery and Heiberg say, that *Plato formulated as a systematic method what the mathematicians had long been applying*…. Plato's influence on these men, then, was that of an *intelligent critic of method*…and it was by his criticism of method, *by his formulation of the broader problems to which the mathematician should address himself,* and, as the summary of Proclus says, by arousing in those who took up philosophy an interest in mathematics that he gave such a great impulse to the development of the science. (Cherniss 1962, 65-66)

In this fragment, Cherniss points to the fact that Plato, also in his collaboration with mathematicians, was not a master, whose solution to a problem cannot be discussed further. His goal was not that of teaching by imposing solutions; rather, he used his insight and skills in the formulation of a problem to offer general advice and methodological criticism to other thinkers (Cherniss 1962, 65). In his writings and interactions with his associates, he aimed at stimulating cognitive growth, pointing at problems and showing a

method, not for the elaboration of a final solution to the issue at stake, but for its reconsideration in light of a different, broader, perspective, which could emerge thanks to open discussion. We are going to see how this hermeneutic horizon informs Plato's concepts of *logistikē* and *arithmētikē*.

2. *Logistikē* and *Arithmētikē*

The concept of *logistikē*, and its distinction from *arithmētikē*, constitutes a complex topic (Fowler 1987, 109). I am going to focus here on the epistemic function of the introduction of this distinction. The distinction of *logistikē* from *arithmētikē* is explicitly mentioned in *Gorgias,* 451 a-c. There, Socrates says that if he were asked with what arithmetic (*arithmētikē* - *Gorgias*, 451 b) deals, he would answer: "it belongs to that knowledge which deals with the even and the odd, with reference to *how much* either happens to be" (Klein 1968, 17). And of *logistic* (*logistikē* - *Gorgias*, 451 c) it is said further on: "it deals with the same thing, namely the even and the uneven; but logistic differs [from arithmetic] in so far as it studies the even and the odd with respect to the multitude which they [the single even and odd] make both with themselves and with each other" (Klein 1968, 17).

This is the interpretation, provided by Klein (Klein 1968, 18-19), of *arithmētikē* and *logistikē*:

> In the face of definite multitudes of things, we habitually *determine their exact number*- we "number," i.e., count, the things (…). In order to be able to count we must know and distinguish the single numbers…Plato calls the totality of this science of all possible numbers the "art of number"-"arithmetic." But we are also in the habit of *multiplying or dividing these multitudes*. This means that we are no longer satisfied with the number by which we have enumerated the things in question, but that we bring to bear on this number new "numbers," whether we wish to separate off a "third" part of the respective quantity or wish to produce a multitude which amounts to "four" times the given one. In such multiplications and divisions, or, more generally, in all *calculations* which we impose on multitudes, we must *know beforehand* how the different numbers

> *are related to one another* and how they are constituted *in themselves*. This whole science, which thus concerns the behavior of numbers toward one another, i.e., their mutual relations, and which first enables us to *relate* numbers, i.e., to calculate with them, is called the "art of calculation" - "logistic".

In this excerpt, Klein points to a crucial distinction between arithmetic and *logistic*: *logistic* is a science addressed to relations of numbers as such; since all calculations are based on relations among numbers, *logistic* provides the common art of calculation with its foundation (Klein 1968, 38). As Cherniss pointed to (see *supra* 1.1.), Plato's influence on mathematicians was that of a skilled critic of the method. He formulated broader problems which mathematicians should address themselves (Cherniss 1962, 66). Plato, introducing the concept of *logistikē*, allows reflections of individuals not to stop at the numbers as the end of the matter. Instead of considering numbers as such, it should examine their relations, as the foundation of the very possibility to calculate. This analysis belongs to a broader perspective, which makes advances cognitively, reflecting on the fact that calculations are based on relations. Plato poses a problem about what calculations are instead of offering a definitive solution, contributing, this way, to his interlocutor's epistemic progress.

2.1 *Logistic* and Arithmetic: Theoretical and Practical

Plato contrasts "practical" arithmetic and "practical" *logistic* with their respective "theoretical" counterparts (Klein 1968, 22). In *Philebus,* 56 d Socrates asks: "Don't we have to agree, first, that the arithmetic of the many is one thing, and the philosopher's arithmetic is quite another?" And to the question of his interlocutor Protarchus, "How could anyone distinguish these two kinds of arithmetic?", he replies (56 d-e): "The difference is by no means small, Protarchus. First, there are those who compute sums of quite *unequal units*, such as two armies or two herds of cattle, regardless of whether they are tiny or huge. But then there are the others who would not follow their example unless it was guaranteed that *none of those infinitely many units differed in the least from any of the others*". And Protarchus makes the point once more with emphasis: "You explain

very well the notable difference among those who make numbers their concern, so it stands to reason that there are those *two different kinds of arithmetic"* (*Philebus*, 56 e). This distinction is immediately expanded to include *logistic* (*Philebus*, 56 e- 57 a), so that Plato explicitly postulates here a *theoretical logistic* (Klein 1968, 22). What differentiates this one from *practical logistic* is the kind of multitude with which each deals. In one case, we are concerned with multitudes of "unequal" objects – and, obviously, all objects of sense are as such. In the other, with multitudes of wholly similar units, there are precisely those which cannot occur in the realm of objects of sense (Klein 1968, 22-23).

Theoretical arithmetic and *logistic* both have as objects, in contrast to the corresponding practical arts, not things experienced through senses (Klein 1968, 6). For Plato, the superior stages of cognitive development are reached when we gradually leave the sensible realm to investigate the non-sensible. The majority of modern investigations deal with explanations of the tangible. Despite this difference, Plato's philosophy of mathematics still has contemporary relevance. Plato's methodological insights create the possibility of considering the topic of calculation from a broader point of view. The introduction of the concept of *logistikē* makes us realize the existence of the problem of what renders calculations possible, expanding our epistemic perspective. Plato gives us the chance to see a problem where a fact that requires no further discussion is commonly seen. This capacity to recognize the necessity of deeply investigating an issue at stake using a novel lens is, also in contemporary times, a source of discoveries. Plato's higher-order pedagogy, which does not offer definitive answers but proposes new points of entrance for reflection, has a crucial role in the advancement of research.

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NOTES

1. See the Tübingen school, in particular Krämer, Hans J. 1990. *Plato and the Foundations of Metaphysics: A Work on the Theory of the Principles and Unwritten Doctrines of Plato with a Collection of the Fundamental Documents,* edited and translated by John R. Catan. Albany: State University of New York Press, and Szlezák, Thomas. 1999. *Reading Plato*, translated by Graham Zanker. London: Routledge.
2 Plato's intellectual stimulations are *not* limited to the *explicit* requests of collaboration between writer and reader, which the philosopher introduces in his dialogues. Plato is also able to elaborate intellectual stimulations, whose meaning is unveiled gradually by the readers who progress rationally. On this topic see my book Saracco, S. 2017. *Plato and Intellectual Development: A New Theoretical Framework Emphasising the Higher-Order Pedagogy of the Platonic Dialogues*. Cham, Switzerland: Palgrave Macmillan. See in particular the second chapter, *The Structure of Rational Engagement in the Reading of Plato*, pp. 13-52.

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