ARCHAEOGENEALOGY OF PROBLEM SOLVING IN MATHEMATICS: ARTICULATIONS BETWEEN FOUCAULT, SPINOZA, AND NIETZSCHE ON AFFECT, POTENCY, AND COGNITION

Luiz Carlos Leal Junior

Federal Institute of São Paulo, Brazil

luizleal@ifsp.edu.br

Abstract

Mathematics education is never neutral: it is shaped by power relations, affective modulations, and cognitive constraints. This article proposes archaeogenealogy as a hybrid method to analyze mathematical problem solving across three dimensions- discursive-institutional, affective-relational, and cognitive-neuropsychological. Drawing on Foucault, Spinoza, and Nietzsche, it interrogates how school practices construct regimes of truth, how affects such as anxiety and curiosity expand or restrict students' cognitive resources, and how values attached to error and correctness reproduce or challenge hierarchies. Empirical vignettes from classrooms and assessments illustrate how small pedagogical shifts- such as rubric redesign- can transform students' affective climate and cognitive availability. The article argues that problem solving functions as a sorting mechanism, often privileging students with greater cultural capital, while penalizing those in vulnerable contexts. By integrating philosophy, psychopedagogy, and cognitive neuroscience, archaeogenealogy opens new possibilities for understanding and transforming mathematics education, foregrounding equity, creativity, and the cultivation of students' potency to think and to act.

Keywords: Archaeogenealogy; Mathematics Education; Problem Solving; Philosophy of Education; Psychopedagogy; Cognitive Neuroscience.

Introduction

"Knowledge is not made for understanding; it is made for cutting" (Foucault, 1972/2002, p. 154). This warning reminds us that school mathematics, far from being a neutral domain of pure reasoning, is shaped by discourses, dispositifs, and values that sort, classify, and discipline. Mathematics education is therefore entangled with power, authority, and ideology. Curricula, assessment systems, and classroom practices are not innocent tools of instruction; they actively produce subjectivities and reproduce social hierarchies (Ernest, 2024).

Within this horizon, this article introduces archaeogenealogy as a methodological device for analyzing mathematical problem solving. By combining archaeological sensitivity to discourses, genealogical attention to historical contingencies, and philosophical insights into affects and values, it illuminates how learning mathematics is traversed by cognitive constraints, affective modulations, and institutional forces. Rather than redescribing this triad at every step, the text mobilizes it selectively, according to the evidence and interventions under discussion.

This article proposes *archaeogenealogy* as a hybrid method for analyzing mathematical problem solving by articulating three mutually informing dimensions: (i) the discursive-institutional level, where curricula, textbooks, and high-stakes assessments define what counts as a legitimate problem or solution; (ii) the affective-relational level, where emotions such as anxiety, curiosity, or confidence modulate students' willingness and ability to engage; and (iii) the cognitive-neuropsychological level, where conditions such as working memory and cognitive load constrain or enable reasoning. Instead of redescribing this triad in every section, it will serve as an orienting framework: each part of the analysis highlights the level most relevant to the evidence and interventions under discussion.

Who gains and who loses

Assessment policies and devices function as technologies of selection. They amplify the advantages of students with greater cultural and economic capital while penalizing those in vulnerable contexts. As Ernest (2024) argues, high-stakes assessment systems act as *sorting* mechanisms that assign unequal values to students and opportunities, thereby reinforcing structural inequalities and raising ethical concerns about educational justice. In practical terms, reforms in rubrics, the balance between process and product, or diversification of assessment formats directly affect students' anxiety, the availability of working memory during tests, and ultimately the reproduction- or reduction- of inequalities.

Assessment policies do not operate in a vacuum. They privilege some students while penalizing others, functioning as mechanisms of social selection. As Ernest (2024) argues, high-stakes testing sustains hierarchies of wealth and power by classifying and labeling. Skovsmose (1994) describes this as part of the "formatting power" of mathematics education: assessments not only measure but also produce differences. Gutstein (2006) further shows how mathematics functions to legitimize broader systems of exclusion.

In practice, students with greater access to cultural capital benefit from assessment formats aligned with their experiences, while those from vulnerable contexts encounter intensified anxiety and reduced cognitive resources. The supposed neutrality of assessment hides its political function: to sustain existing hierarchies.

Recognizing these dynamics is crucial for psychopedagogy and teacher education. Without confronting who gains and who loses, problem solving risks becoming an instrument of stratification rather than liberation.

Problem solving consolidated itself as a central axis of mathematics education from the second half of the twentieth century onwards. In international documents, such as the reports of the National Council of Teachers of Mathematics (NCTM) in the 1980s and 2000s, it appears as a central goal: to learn mathematics would mean, to a large extent, being able to solve new problems, not merely to repeat algorithms (NCTM, 1989, 2000). In Brazil, this emphasis was echoed in curricular guidelines and, more recently, in the *Base Nacional Comum Curricular* (BNCC), which establishes problem solving as a privileged strategy for developing mathematical competencies. However, valorization has not eliminated tensions: many students still face problems treated mechanically, disconnected from meaningful contexts, reinforcing logics of reproduction and anxiety rather than creation and understanding (Brasil, 2018).

To grasp this scenario, it is necessary to recognize that problem solving is not a neutral practice. It is traversed by historical traditions, epistemological disputes, and institutional forces. What counts as a "problem" in school mathematics does not arise solely from the nature of the discipline but from social and political choices. Textbooks, standardized tests, and large-scale assessments select certain types of problems while marginalizing others. These choices shape students' modes of subjectivation, determining who is recognized as "good at mathematics" and who is relegated to the stigma of difficulty.

It is in this terrain that the proposal of archaeogenealogy becomes pertinent. Foucault's archaeology invites us to interrogate the discourses that organize the field: which statements sustain the idea that problem solving is the essence of school mathematics? Genealogy, in turn, allows us to trace the historical and institutional conditions that consolidated such statements: the rise of standardized testing, mass schooling, and the transformation of mathematics into a criterion of social selection (Foucault, 1969/1972, 1975/1995). The analysis does not rest on grand linear narratives but shows that the present is woven by contingencies, ruptures, and disputes (Leal Junior & Onuchic, 2020, 2025).

Yet understanding only the discursive level is not sufficient. Spinoza offers a key to thinking about the affects that traverse the classroom. Anxiety, hope, joy, or frustration are not secondary states: they expand or restrict the power of thought. When a student confronted with a problem is overtaken by math anxiety- a phenomenon widely documented- this is not merely a psychological flaw but an affection that diminishes their *conatus*, reducing their capacity to mobilize cognitive resources. The Spinozist reading reinstates affects as central variables of learning, without reducing them to mere “subjective emotions.”

Nietzsche, in turn, urges us to question the values crystallized around error and correctness. His genealogy shows that no category is neutral: to label something as “right” or “wrong” implies a network of sedimented values, often inherited from traditions that bind mathematics to obedience, discipline, and hierarchy. To ask, with Nietzsche, about the provenance of these values opens the possibility of imagining other practices in which error becomes a force of creation, diversity of approaches is valued, and mathematics is lived as an exercise of freedom rather than a tool of control.

This philosophical reading finds resonance in contemporary cognitive psychology and neuroscience. Research consistently demonstrates that working memory is a limited but decisive resource for mathematical reasoning: it supports hypothesis maintenance, symbol manipulation, and multi-step coordination (Baddeley, 2000; Sweller, 1988). When overloaded by distractions or negative affects such as anxiety, its functioning is compromised (Ashcraft & Krause, 2007; Passolunghi et al., 2016). Studies on math anxiety show that anxious students devote a significant portion of their cognitive resources to intrusive thoughts, thereby reducing their efficiency in problem solving. This confirms, in empirical language, Spinoza’s intuition that affects modulate the power of action, and adds neuroscientific depth to the argument that school devices can either increase or diminish students’ real capacities.

At the same time, investigations in psychopedagogy indicate that difficulties in mathematics cannot be explained solely by individual deficits but also by relational and institutional factors. The way teachers formulate problems, the modes of assessment, and the emotional climate of the classroom directly influence performance. This resonates with Foucault’s critique of school dispositifs and Nietzsche's genealogy of the values attributed to success or failure (Boaler, 2016).

The pertinence of an archaeogenealogy of problem solving in mathematics can thus be understood through three analytical planes that intertwine in a complex weave (Leal Junior & Onuchic, 2020, 2025). The first is the historical-discursive plane. Problem solving, presented today as the unquestionable core of school mathematics, does not occupy this place by virtue of an atemporal essence, but because of specific historical contingencies. International documents, such as NCTM's reports from the 1980s and 2000s, as well as national guidelines such as the BNCC, conferred upon it centrality and legitimacy. Foucault's archaeology shows that this position is neither natural nor universal: it was produced by discourses, dispositifs, and institutional practices- standardized tests, textbooks, evaluative rubrics- that shaped what counts as "school mathematics" and which forms of reasoning are recognized as valid. What appears as universality is, in fact, the outcome of political and epistemological choices that, by naturalizing certain ways of thinking, marginalized others.

The second plane is the affective-cognitive. Problem solving is not a purely technical act restricted to algorithmic application. It is an experience in which affects and cognitive processes are continuously entangled. Spinoza had already pointed out that affects such as joy, hope, fear, or anxiety directly modulate the power of thought, either expanding or restricting the capacity for action (Spinoza, 1677/2002). This philosophical intuition finds support in contemporary cognitive neuroscience: research shows that working memory, essential for maintaining hypotheses, manipulating symbols, and coordinating problem-solving steps, is limited and highly vulnerable to affective interferences. When math anxiety takes over, intrusive worries consume attentional resources and reduce performance, especially in tasks that require elaborate reasoning. This dimension reveals that learning is simultaneously rational and affective, legitimizing the need for an integrated approach that unites psychopedagogy, philosophy, and cognitive science.

Finally, there is the value-critical plane. Nietzsche's genealogy shows that categories such as "error," "correctness," or "creativity" are not neutral but carry historical values linked to ideals of discipline, obedience, and productivity (Nietzsche, 1887/2006). What today seems self-evident- the glorification of correctness, the devaluation of error, the myth of genius- is in fact the result of historical processes of valuation that can and should be interrogated. By problematizing these values, space opens for pedagogical transvaluation: error ceases to be a sign of failure and becomes an opportunity for invention; the diversity of strategies ceases to be an undesirable noise and is recognized as a source of heuristic richness. This critical shift allows school mathematics to be reimagined not as a field of rigid obedience but as a space of creative freedom, where each student can experiment with singular ways of thinking and reinvent modes of problem solving.

By crossing Foucault's archaeological gaze, Spinoza's philosophy of affects, and Nietzsche's genealogy of values, archaeogenealogy reveals that mathematical problem solving is less a neutral technique than a field of forces in which subjectivation, cognitive possibilities, and ethical horizons of creation are at stake. Proposing a conversation between Foucault, Spinoza, and Nietzsche therefore does not amount to a merely erudite exercise, but articulates philosophy, psychopedagogy, and neuroscience in an interdisciplinary approach capable of illuminating the contemporary dilemmas of mathematics education. What is at stake is not only the technical efficacy of problem solving but the very constitution of subjects: disciplined or creative, anxious or potent, submissive or inventive. Archaeogenealogy thus opens a decisive horizon: what kind of mathematics do we wish to cultivate in our schools- one that reinforces hierarchies and control, or one that expands the power to think and to live?

Theoretical Framework

The proposal of an archeogenealogy of problem solving in mathematics requires a dialogue with three distinct yet complementary philosophical traditions: Michel Foucault's archaeology and genealogy, Baruch Spinoza's philosophy of affects, and Friedrich Nietzsche's genealogy of values. Each provides a set of concepts and analytical sensitivities that, when articulated together, make it possible to understand how discourses, affects, and values traverse the act of learning and teaching mathematics.

Ontological Grounding and Philosophical Tensions

Before detailing each tradition, it is necessary to make explicit the philosophical presupposition that enables the articulation of Foucault, Spinoza, and Nietzsche within a shared analytical horizon. The point of convergence lies in the rejection of the neutrality of knowledge and the centrality of forces, discursive, affective, and axiological, in the constitution of subjects. In different registers, the three thinkers demonstrate that teaching and learning are not purely technical acts, but experiences traversed by relations of power, bodily modulations, and value disputes.

This approximation, however, does not eliminate tensions. For Foucault, power presents itself as a network of practices and dispositifs that organize the field of the possible; in Nietzsche, the emphasis falls on the affirmative will of creation and the genealogy of values; in Spinoza, potency is not conceived as domination, but as the effort to persevere and expand existence (*conatus*). Rather than dissolving these differences into a synthesis, archaeogenealogy proposes to mobilize them as critical complementarities: it is precisely in the friction between conceptions of power, potency, and value that a fertile space opens for understanding mathematical problem solving as a field of multiple forces, where subjects are formed, affects modulate thought, and values orient what is regarded as error or creation.

Foucault: Archaeology, Genealogy, and Regimes of Truth

In works such as *The Archaeology of Knowledge* (1969) and *Discipline and Punish* (1975), Michel Foucault developed tools for analyzing how knowledge and social practices are historically constituted. Archaeology seeks to identify the discursive formations that establish what can be said, thought, and done within a given field. In the case of school mathematics, it reveals that categories such as "problem," "method," "proof," or "error" are not neutral, but the products of historical rules of enunciation.

Genealogy, in turn, examines how these practices are rooted in relations of power. What appears neutral, such as standardized testing, textbook structures, or grading rubrics that privilege a single solution path, is in fact permeated by strategies of governance and discipline. Analyzing mathematical problem solving through this lens clarifies why certain procedures gain prestige (such as the "correct" algorithm), while others are rendered invisible (intuitive strategies, unconventional explanations).

In everyday schooling, this means that problem solving is not merely a cognitive activity, but also a device of subjectivation: it produces disciplined students, hierarchizes intelligences, legitimizes some modes of thinking, and disqualifies others. Foucault thus invites us to question what seems self-evident: why do we call certain exercises "problems"? Who decides what counts as a "good solution"? What regimes of truth sustain these choices?

Spinoza: *Conatus*, Affects, and the Power to Act

In his *Ethics* (1677), Baruch Spinoza conceived affects as modifications of the body that increase or diminish the power of existing and acting. The concept of *conatus*, the effort of each being to persevere in its existence, shows that thinking and learning are not detached from the body, but inseparable from affective states.

Applied to mathematics education, this means that emotions such as anxiety, frustration, hope, or joy are not peripheral “noise,” but constitutive conditions of the act of learning. Contemporary research in cognitive neuroscience confirms this intuition: mathematical anxiety, for example, consumes working memory resources, limiting the capacity to reason under pressure. Spinoza thus offers a key to understanding how affects modulate problem solving: they may open the mind to heuristic creativity or constrain it to mechanical repetition.

Reading the classroom through a Spinozist lens means paying attention to the forces circulating between teacher and students, and to how trust, fear, or enthusiasm expand or restrict the capacity to think mathematically. In this sense, psychopedagogy finds in Spinoza a philosophical ally, recognizing that learning is not only a matter of method, but also of mutual affective modulation.

Nietzsche: Genealogy of Values and the Creation of Perspectives

In *On the Genealogy of Morality* (1887), Friedrich Nietzsche demonstrated that concepts seemingly universal, such as “good,” “evil,” “right,” or “wrong,” are the products of historical processes and value disputes. His genealogy reveals that values are not natural but constructed within contexts of power.

When applied to mathematics education, Nietzsche’s perspective forces us to reconsider categories such as “error,” “correct reasoning,” “valid method,” or “gifted student.” These are, in fact, historical constructions imbued with social and cultural values. By treating them as natural, schooling reproduces hierarchies that distinguish “good” and “bad” ways of thinking, legitimizing some while marginalizing others. As Nietzsche suggests, tracing the origin of these classifications shows that they are not inevitable, but products of disputes, institutional contexts, and power interests.

Nietzsche’s contribution unfolds in two complementary directions. First, the critical gesture: denaturalizing school hierarchies and showing that what often appears self-evident, such as the supremacy of one algorithm, the exclusivity of a strategy, or the distinction between the "talented" and the "average" student, is not an expression of mathematical essence, but the outcome of historical and cultural choices. What is presented today as unquestionable was once only one possible decision, sustained by power struggles and values that became normative.

Second, the propositional gesture: the idea of transvaluation. Here the task is to reopen the field of possibilities, shifting attention to what was once relegated to failure or error. Error ceases to be interpreted as a sign of incapacity and becomes an occasion for invention, a heuristic force capable of opening new paths of thought. The plurality of strategies, even those that escape expected standards, is legitimized as the expression of diverse modes of reasoning, rather than as deviations to be corrected. Within this horizon, the courage to take risks, experiment, and venture into uncertain paths becomes a central pedagogical value.

Nietzsche's contribution is therefore not merely critical, but also inventive. It demands that mathematics education move beyond reproducing hierarchies and dare to transvalue the values that structure its practices, opening space for mathematics to be lived as a creative, risky, and profoundly human experience. In this sense, Nietzsche challenges education to form not merely compliant subjects, but creators willing to experiment, fail, and reinvent. His provocation is clear: if schools lack the courage to subvert rubrics and hierarchies, problem solving risks becoming nothing more than repetitive technical training, devoid of vitality. To educate, for Nietzsche, is above all to stimulate the *will to power*, that is, the disposition of each student to expand their modes of thinking and creating, rather than reducing them to a normative ideal of correctness.

Articulating Foucault, Spinoza, and Nietzsche

The articulation of Foucault, Spinoza, and Nietzsche is not merely a mosaic of heterogeneous references, but a genuine lens for understanding mathematical problem solving in its full complexity. Each thinker contributes a singular dimension, but their power emerges in their interweaving. Foucault shows that problem solving is not only a pedagogical procedure but also an institutional device. Exams, textbooks, curricula, and grading rubrics are not neutral instruments; they function as mechanisms that define which ways of thinking are legitimized and which are disqualified, instituting regimes of truth that discipline both subjects and practices.

Spinoza, in turn, reminds us that affects are not marginal to learning: they constitute the very power to act. Joy, curiosity, and trust expand the capacity to reason, while fear, anxiety, and shame drastically reduce it. This philosophical insight resonates with contemporary cognitive neuroscience, which demonstrates how working memory and attention are modulated by emotional states, revealing the interdependence of body, mind, and learning.

Nietzsche then opens the critical and creative horizon by questioning and recreating the values that sustain school mathematics. Categories such as "error," "correction," or "genius" are not universal truths but historical inheritances shaped by hierarchies and power struggles. His invitation is to transvaluation: transforming error into inventive potential, turning norms into occasions for creation, and replacing fear with the courage to experiment.

Placed in dialogue, Foucault, Spinoza, and Nietzsche offer not only complementary interpretations but a common field of thought that allows us to reimagine mathematics education. Problem solving ceases to be conceived as an isolated technique and is instead understood as a discursive practice, an affective experience, and an opportunity for creation, a field of forces where the destinies of teaching and learning are played out.

This conceptual triangulation shapes the core of the archeogenealogy proposed here. It is a method that does not simply describe pedagogical practices, but interrogates them on three simultaneous planes: the discourses that sustain them, the affects that traverse them, and the values that structure them. By articulating these levels, archeogenealogy makes it possible to understand mathematical problem solving not only as a technical exercise but as a field of forces in which subjects are produced, and as a site of creation where the power of thought can be expanded, reinvented, and liberated.

Bridge to Cognitive Neuroscience: Working Memory, Anxiety, and Philosophical Readings

Research in cognitive psychology and neuroscience has consistently shown that working memory plays a central role in mathematics learning. Solving problems requires maintaining hypotheses, manipulating symbolic representations, and coordinating multiple steps of reasoning. It is a limited-capacity cognitive resource, and overload directly compromises performance.

Within this context, mathematical anxiety emerges as a highly relevant factor. Empirical studies indicate that intrusive concerns, linked to fear of making mistakes or of being evaluated, consume attentional resources, leaving less available working memory for processing problem-solving steps. The result is a significant performance decline, especially in more complex tasks. In other words, affect does not merely accompany cognition: it structurally modifies it.

However, these findings acquire new depth when interpreted through philosophical lenses. From a Foucauldian perspective, the very conditions that generate anxiety are not purely psychological, but institutional. Standardized tests, surveillance-oriented classroom practices, and rigid evaluative rubrics function as dispositifs that produce anxiety, which in turn overloads working memory. Spinoza would read the same phenomenon as an *affectus tristis*: an affection that diminishes the *conatus*, restricting the student's power to think and act. Nietzsche, for his part, would emphasize that such anxiety reflects the genealogical weight of values sedimented in school culture, values that glorify speed, correctness, and obedience while disqualifying hesitation, slowness, and creative deviation. Anxiety, then, is not simply a neural response but a symptom of cultural valuation that molds subjectivities into docility rather than invention.

This interdisciplinary reading shows that cognitive data cannot be treated as self-sufficient evidence. The true power of neuroscientific measures lies in their re-signification when placed in dialogue with philosophy. Cognitive neuroscience does not replace Foucault, Spinoza, or Nietzsche; rather, it extends their insights, grounding them in empirical traces of memory, attention, and affective modulation. Conversely, philosophy prevents a reductive interpretation of brain data, situating it within the discursive, affective, and value-laden structures that shape what it means to "do mathematics" in school.

Thus, the bridge between philosophy and neuroscience is not ornamental but structural. It reveals that problem solving is always a field of forces, where cognitive processes, affective modulations, and historically produced values intersect, and that only an interdisciplinary approach can adequately address this complexity.

Modus Operandi: Archaeogenealogy as a Methodological Device

The archaeogenealogy proposed here should not be understood as an analytical metaphor, but as a methodological strategy in its own right, capable of articulating different investigative operations within a single gesture. Inspired by Foucault, Spinoza, and Nietzsche, it encompasses the examination of institutional discourses and practices, the mapping of affects that modulate learning, and the analysis of cognitive processes involved in mathematical problem solving. The aim is not to propose a universal model, but to construct a flexible, rigorous, and situated heuristic, capable of illuminating contextual mechanisms without relinquishing empirical consistency.

Integration of Operations

Archaeogenealogy operates iteratively rather than linearly. In a first movement, school and institutional materials, textbooks, assessments, public policy reports, are subjected to archaeological analysis to identify categories, statements, and discursive regimes that define which problems are considered legitimate and which strategies are valued. This mapping then guides the entry into the ethnographic field, where the microdynamics of the classroom (interactions, gestures, silences) reveal how such discourses materialize in everyday practices. Ethnographic data, in turn, indicate which affects circulate within the school environment and how they modulate the potency to learn. At this point, neurocognitive measures (working memory tests, performance records, anxiety indicators) are integrated, not as isolated variables, but as evidence reinterpreted in light of the philosophical framework.

In other words, cognitive data acquire full meaning only when read in correlation with the institutional dispositif (Foucault), with the affective modulation of the conatus (Spinoza), and with the historical valuation of error and correction (Nietzsche). The methodological movement is therefore one of back-and-forth: discourses orient ethnography, which connects to cognitive data, which are re-signified within the philosophical field, returning to the institutional level in the form of problematization.

Interventional Dimension

Archaeogenealogy is not limited to describing practices; it also opens itself to intervention in partnership with teachers. This dimension is not external to the method but constitutive of it: by identifying how discourses, affects, and values structure problem solving, the next step is to propose small institutional reconfigurations, such as the modification of evaluative rubrics, the flexibilization of examinations, or the introduction of activities that foster curiosity and confidence.

In the projects analyzed, for instance, teachers actively participated in the redefinition of assessment criteria, assigning weight not only to the final result but also to the process, to the justifications, and to creative strategies. This collaboration demonstrated that seemingly modest transformations can reshape the affective climate of the classroom, free working memory resources, and displace crystallized values surrounding "error" and the "right answer."

In this way, the interventional dimension confirms that archaeogenealogy is not merely a critical lens but also a creative dispositif: by articulating analysis and intervention, it constructs new possibilities of subjectivation within the field of mathematics education.

Results and Contributions

Analytical Scene: The Fractions Test

In a middle school classroom of approximately thirty students, a fractions test was administered with the stated aim of evaluating both procedural fluency and conceptual understanding. Despite the teacher's intention, the majority of responses revealed a strong reliance on memorized algorithms- particularly cross-multiplication and the "rule of three." Only a few students attempted to reason proportionally or to connect the problems to everyday contexts, such as sharing food or interpreting percentages. The overall pattern illustrated a broader tendency already documented in the literature: classroom assessments often privilege speed and algorithmic accuracy over conceptual flexibility and meaning-making (Schoenfeld, 2013; Boaler, 2016).

The affective dynamics were equally revealing. Some students worked quickly and with apparent confidence, while others hesitated, erasing repeatedly or freezing in silence. For these students, the fear of being wrong seemed to outweigh the task itself, generating a visible tension that impaired their reasoning. This resonates with research in cognitive psychology showing that anxiety consumes working memory resources, leaving fewer attentional capacities available for problem solving (Ashcraft & Krause, 2007; Ramirez et al., 2018).

An archaeogenealogical reading brings into focus the multiple forces condensed in this seemingly ordinary classroom event. Foucault would emphasize that the test functions not merely as a diagnostic instrument but as a disciplinary dispositif: by prescribing a “correct” algorithmic path, it legitimizes specific modes of reasoning while rendering alternative strategies invisible. Spinoza would highlight the affective consequences: for some students, the test fostered confidence and expanded their conatus; for others, it provoked shame and anxiety, thereby reducing their ability to mobilize working memory and sustain reasoning. Nietzsche would push further, reminding us that the very categories of “error” and “merit” are not natural but historically sedimented values, tied to ideals of obedience, selection, and productivity. To transvalue these categories would mean reimagining assessment practices so that error becomes an opportunity for invention rather than a source of stigma (Black & Wiliam, 1998).

Thus, even a modest classroom episode such as a fractions test exposes the entanglement of discursive, affective, and value-laden dimensions. It reveals how school mathematics simultaneously operates as a cognitive challenge, an affective experience, and a political device of classification. The integrated reading of this scene underscores three interwoven dimensions: (1) the school problem as a discursive-institutional dispositif (Foucault) that produces subjects; (2) the modulation of affective potencies (Spinoza), which directly shape cognitive resources such as working memory; and (3) the value-charged dimension (Nietzsche), which calls for transvaluation to open pedagogical spaces more inclusive of plurality, creativity, and risk-taking.

Standardized Large-Scale Assessment

In a Brazilian state-level system, large-scale standardized assessments introduced in the 2010s sought to “bring mathematics closer to real life” by emphasizing financial contexts (interest rates, discounts, consumption). Official discourse presented this as democratization. Yet results showed that students from wealthier backgrounds consistently outperformed their peers from vulnerable communities. These students also reported lower levels of math anxiety.

Critical mathematics education has long warned that high-stakes testing functions as a sorting and labeling mechanism rather than a neutral measure (Skovsmose, 1994; Gutstein, 2006;

Ernest, 2024). From an archaeogenealogical lens, the test codifies a specific economic rationality- market-oriented mathematics- as the norm. The affective dimension is equally relevant: students unfamiliar with financial discourse exhibited heightened anxiety, consuming working memory resources and undermining reasoning (Ashcraft & Krause, 2007; Ramirez et al., 2018).

Thus, what appears as a technical matter of assessment is in fact a reproduction of inequality. Those with access to cultural capital are advantaged, while others are penalized. Nietzsche would remind us that the privileging of speed, correctness, and utility reflects sedimented values of productivity and obedience. To transvalue such values requires assessment designs that reward diverse strategies and reduce affective costs.

Transformation of Rubrics in the Classroom

In a high school setting, a teacher redesigned assessment rubrics to grant credit not only for final answers but also for reasoning processes, alternative approaches, and conceptual insights. This small shift altered classroom dynamics dramatically. Students who previously avoided participation began to share their work openly, reporting reduced fear of being wrong. Teachers observed an increase in collaborative discussion and exploratory reasoning.

Psychopedagogical research corroborates these findings: valuing processes enhances confidence and deepens learning (Andrade, 2010; Black & Wiliam, 1998). From a Spinozist perspective, this rubric redesign cultivated active affects- joy and curiosity- that expanded students' potency to think. Cognitive neuroscience confirms that such affective safety frees working memory, enabling more sustained reasoning (Carey et al., 2022). Nietzsche would frame this as a transvaluation of values: error is reimagined not as failure but as generative force.

This vignette demonstrates that modest changes in classroom dispositifs can destabilize sedimented values and open new ethical and cognitive possibilities for mathematics education.

Although modest in scale, this vignette illustrates the transformative potential of rethinking assessment criteria. A simple shift in rubrics- moving from a punitive logic of correctness toward a generative logic of plurality- can alter not only students' affective experiences but also the ethical fabric of school mathematics.

Questions Emerging from the Research and Proposal of This Article

The archaeogenealogy of problem solving in mathematics, as outlined in this work, is not limited to a theoretical gesture of analysis. On the contrary, it functions as a lens that, while describing the present, opens fissures to rethink teaching, assessment, and training practices. In this movement, questions inevitably arise, not only methodological or empirical ones, but philosophical and pedagogical inquiries that put into debate the very foundations of what we call mathematical learning.

These questions do not emerge from nowhere. They are produced by the articulation of the three axes that intersect here: Foucault's critique of school dispositifs, Spinoza's conception of affects as modulators of the power to act, and Nietzsche's provocation to transvalue values sedimented in school culture. When these references are brought to the fields of psychopedagogy and cognitive neuroscience, the result is a fertile ground of problematizations that challenges both researchers and classroom teachers.

The following questions are therefore inevitable unfoldings of the archaeogenealogical proposal: inquiries still under construction, but which can be illuminated by the voices analyzed here, Foucault, Spinoza, and Nietzsche. The exercise, far from a rhetorical game, seeks to show how the contributions of these thinkers not only problematize problem solving in mathematics but also offer clues on how to redesign practices, dispositifs, and educational policies.

How do curricular discourses, assessment rubrics, and pedagogical practices articulate to produce a dominant definition of "problem solving"?

Foucault would respond that the curriculum and assessments function as dispositifs of power-knowledge. They do not merely describe problem solving; they fabricate it as a norm, defining what counts as valid reasoning. The test, the textbook, and the rubric are gears that configure "mathematically competent" subjects and exclude unlegitimated practices.

Spinoza would say that such dispositifs act directly upon students' potency. A curriculum that values only speed and accuracy fosters affects such as fear and anxiety, diminishing the *conatus*. Conversely, if the curriculum makes room for diverse explorations, it promotes joy and curiosity, expanding the capacity to act.

Nietzsche would remind us that the dominant definition is not neutral, but the result of sedimented values: efficiency, utility, obedience. He would suggest transvaluing these values, making room for creation and plurality of mathematical thinking styles.

How do changes in the assessment regime modulate affects and, consequently, cognitive resources such as working memory?

Foucault would emphasize that changing the assessment means changing the dispositif: if the exam ceases to be disciplinary and starts valuing processes, the student-subject is produced differently, less surveilled, more experimental.

Spinoza would explain that reducing the pressure of error and time fosters affects of confidence and curiosity, which in practice increase the potency of cognitive resources. Anxiety, which blocks working memory, is replaced by affects that enhance it.

Nietzsche would provoke that a change in the assessment regime is also a change in values. If the "correct" ceases to be only the result and comes to include creativity and effort, then the school realizes a transvaluation that can open more fertile paths for thought.

What historical trajectories explain the hegemony of certain heuristics in textbooks and national exams?

Foucault would point out that this hegemony is the result of historical sedimentations in pedagogical dispositifs, linked to control and comparability among students. Genealogy shows how certain heuristics became dominant because they served the demands of governmentality: measuring, classifying, ordering.

Spinoza would remind us that these trajectories are not limited to discourses: they modulate collective affects. The repetition of "safe" heuristics reduces institutional risk and anxiety, but at the cost of diminishing creative potency.

Nietzsche would say that the hegemony of heuristics is an expression of the morality of obedience applied to mathematics. The genealogy of values shows that the exaltation of quick, mechanical calculation responds to the historical valorization of discipline, utility, and predictability.

Which psychopedagogical interventions, aligned with results on working memory and math anxiety, are most effective in promoting autonomy and creativity?

Foucault would warn that such interventions cannot be limited to the individual, but must transform school dispositifs. Changing rubrics, reorganizing tests, redesigning the curriculum are ways of altering the regimes of truth that sustain anxiety.

Spinoza would insist that interventions must cultivate active affects, confidence, joy, hope. Collaborative activities, valuing process, and reducing error stigma are paths to increase students' *conatus*.

Nietzsche would defend interventions that encourage risk, boldness, and experimentation. An education that promotes autonomy is one that transvalues error: from failure to creative potency, from defeat to rehearsal of new perspectives.

Broader Implications for Psychopedagogy and Teacher Education

The implications of an archaeogenealogy of problem solving in mathematics for psychopedagogy and teacher training cannot be underestimated. They touch the core of what it means to teach and learn mathematics. If we admit that school dispositifs are not neutral, but operate as mechanisms that produce subjects, modulate affects, and organize values, then it is not enough to train teachers merely in techniques of content transmission. It is necessary to cultivate critical awareness capable of diagnosing how the most ordinary practices, a test, a rubric, a classroom activity, are traversed by political, historical, and epistemological choices.

In this sense, reflective training must be repositioned: instead of training teachers only in "effective" methodologies, they must be equipped to analyze discourses, question dispositifs, and understand the affective-cognitive dynamics structuring their own pedagogical practice.

This requirement leads directly to psychopedagogy. Spinoza reminds us that learning is inseparable from being affected, and cognitive neuroscience confirms that anxiety and negative emotions drain working memory resources, while joy and curiosity expand reasoning capacity. Thus, affective mediation is not a peripheral adornment, but the very core of educational practice. A teacher who embraces error, who values attempts, who recognizes effort as a legitimate part of the learning process is not merely creating a friendlier classroom climate: they are directly intervening in students' cognitive architecture, freeing mental energy for complex reasoning and stimulating creative potency. This type of psychopedagogical intervention must be understood as fundamental. It is neither luxury nor romanticism; it is pedagogical rigor supported by philosophy and science.

Archaeogenealogy also compels us to think of pedagogical practices on three integrated levels:

- On the **discursive-institutional level**, it is necessary to revise grading rubrics, make resolution times more flexible, and design problems that admit multiple solutions. This does not mean abandoning rigor, but redefining it to recognize and value different styles of reasoning.
- On the **affective-relational level**, the challenge is to build environments where confidence and curiosity prevail over fear of error, shame of exposure, or anxiety about evaluation.
- On the **cognitive-neurobiological level**, it becomes indispensable to use pedagogical strategies already proven effective: externalization of steps, dual coding, scaffolding, automatization of basic operations. These practices reduce working memory overload and create the necessary cognitive conditions for students to think creatively and inventively.

For this to be possible, teacher education cannot be understood as a one-time event, but as a continuous and collaborative process. Teachers need institutional spaces where they can critically reflect on their practices, share experiences, and analyze learning data in light of research in psychopedagogy and neuroscience. In these spaces, the teacher ceases to be merely a transmitter of content and also becomes an investigator of their own pedagogical dispositifs. This professional posture shift is decisive: it is what can transform the classroom into a living laboratory of invention and reflection.

However, there is an ethical dimension underlying all of this. Interventions that affect students' emotions and cognitive resources cannot be undertaken without responsibility. It is necessary to avoid stigmatization, respect individual rhythms, guarantee informed consent in research, and ensure that the pursuit of results does not become a new form of oppression. Foucault would warn against the risk of transforming any innovation into yet another dispositif of control; Spinoza would remind us that the power to think depends on the quality of affects cultivated; Nietzsche would demand courage to transvalue values without succumbing to the temptation of creating new dogmas. Psychopedagogy, in this framework, must act as guardian of balance, ensuring that no cognitive gain justifies intensifying affective suffering.

Ultimately, the greater implication is that training teachers means forming subjects capable of critically operating at the three levels of archaeogenealogy. Teachers who perceive the discourses shaping what is called "school mathematics," who notice the affects circulating in every pedagogical gesture, and who have the courage to subvert hierarchies in order to expand students' creative potency. It is within this horizon that problem solving can cease to be technical training and become a full formative experience, traversed by discourses, modulated by affects, structured by values, and above all, open to invention.

What can be observed, therefore, is that the archaeogenealogy of problem solving is not confined to abstract critique. It is concretized in the analysis of real practices, large-scale assessments, and transformations of classroom rubrics, showing that mathematics education is traversed by discourses, affects, and values that can be questioned and reinvented. By integrating philosophy, psychopedagogy, and cognitive neuroscience, the proposal opens a horizon where mathematics can be lived not only as technique, but as a formative, creative, and profoundly human experience.

Contributions and Limitations

At this point in the essay, it is important to gather the path that has been traced and make explicit what has, in fact, been constructed. Archaeogenealogy, as conceived here, is not presented as a mere rhetorical resource, but as a hybrid method capable of operating across different layers of the educational experience. Its value lies precisely in the articulation of three dimensions that are often treated in isolation: the critique of discourses and dispositifs

(Foucault), the analysis of affective potency (Spinoza), and the attention to the cognitive and neurobiological conditions of learning (in dialogue with contemporary neuroscience). This intertwining offers an original lens through which to understand mathematical problem-solving as a complex phenomenon, shaped by institutional, affective, and cognitive forces.

Among the contributions achieved in this essay, the most evident is the introduction of archaeogenealogy as a hybrid method capable of operating simultaneously on three levels: discursive, affective, and cognitive. This perspective demonstrated that problem-solving cannot be reduced to a decontextualized technique, as it is often treated in curricular documents or pedagogical manuals, but must be understood as a situated experience, shaped by power relations, modulated by affective states, and sustained by neurocognitive conditions. Pedagogical practice, viewed through this lens, ceases to be the simple transmission of procedures and becomes instead a field of forces, in which discourses, emotions, and cognitive resources intertwine in the constitution of learning subjects.

Another key point is the demonstration that this approach is not limited to the theoretical plane, but can be translated into concrete heuristics for pedagogical intervention. Throughout the text, we have seen how archaeogenealogy can inspire both the critical analysis of standardized examinations, revealing the normativities crystallized within them, and the reconfiguration of evaluative rubrics that shift the focus from results to processes of invention and creativity. It also proved possible to create environments in which curiosity is fostered and mathematical anxiety is reduced, allowing learning to emerge under fairer and more productive conditions.

Perhaps the boldest contribution, however, was the construction of an analytical dialogue between Foucault, Spinoza, and Nietzsche. This scene was not merely illustrative or literary; rather, it generated new analytical categories, such as the notion of the "resolutive dispositif," "affective potency," and "heuristic transvaluation." These categories can be mobilized both in academic research and in classroom practice. They not only provide critical tools to denaturalize established pedagogical practices but also open horizons for imagining alternative ways of teaching and learning mathematics.

It is necessary, however, to acknowledge limits and ethical cautions. The essay, by its very nature, constitutes an analytical exercise grounded in philosophical assumptions. Even though it is anchored in empirical data and dialogues with consolidated literature, the path it proposes requires continuous verification if it is to establish itself as a robust research program. Moreover, any intervention that touches upon evaluative practices and students' affective states must be conducted responsibly: it demands informed consent, psychopedagogical support, and constant care to avoid stigmatization or emotional overload that could exacerbate inequalities. Finally, it is essential to respect the specificity of philosophy. Neither Foucault, nor Spinoza, nor Nietzsche wrote about mathematics education; mobilizing them here means using them as heuristic tools capable of provoking new readings and illuminating hidden tensions, but not as sources of ready-made solutions or pedagogical recipes.

This balance between contributions, limits, and ethical cautions is what gives consistency to the proposal. It allows archaeogenealogy to present itself not as a panacea, but as a critical and creative horizon for rethinking problem-solving in mathematics, while keeping alive the invitation to suspicion, reflection, and invention.

Coda

To think of mathematical problem-solving through the lens of archaeogenealogy is, above all, a political and pedagogical gesture. It is political because it exposes that curricula, assessments, and rubrics are not neutral: they produce subjects, hierarchize knowledge, and reinforce values. It is pedagogical because it opens horizons for practices that go beyond algorithmic training, fostering creativity, the potency of affects, and the diversity of cognitive strategies.

By articulating philosophy, psychopedagogy, and cognitive neuroscience, the essay has shown that every mathematical problem in the classroom is also a field of forces: it decides who can learn, who feels authorized to take risks, who finds space to invent, and who is silenced.

Archaeogenealogy does not aim to offer manuals for immediate application. Its role is different: to invite suspicion of what we have naturalized and to reconstruct school practices in more democratic and creative ways. If taken seriously, it can contribute to reducing anxiety, amplifying potency, and stimulating invention, three essential movements for a mathematics education that not only teaches how to solve problems but also helps form subjects capable of thinking the world in a critical and inventive key.

And, as a final imaginative gesture: if Nietzsche were present, he would celebrate the risk of reinventing rubrics and breaking with the morality of obedience; Spinoza would remind us that the potency of thought depends on the nourishment of affects; and Foucault would caution us against transforming archaeogenealogy into yet another dispositif of control. The strength of the method lies precisely in remaining open, critical, and attentive to singularities.

In short, the archaeogenealogy of mathematical problem-solving is an invitation to think of mathematics not as an end in itself, but as a lived experience: traversed by discourses, modulated by affects, structured by values, and always open to creation.

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